

MACMILLAN'S
CLASS PICTURES
FOR SENIORS

REFERENCE BOOK

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REFERENCE BOOK

1. Chart of Prehistoric Epochs. (*Vol. II., p. 180*). Types of animal life to be found on earth in prehistoric times.

EARLY PALAEOZOIC. (Palaeozoic=early ancient animals.)

Notice at top of picture two lobsterlike jointed creatures and at bottom, oval pointed forms not unlike woodlice, but with bodies divided by deep grooves into three lobes (hence their name—trilobites). All these are primitive arthropods, related to present-day scorpions. They were accompanied by fishes, ancestors of the sturgeons found to-day in Russian and central European countries, but so rare in England that if caught they are the king's perquisites, (royal sturgeon). Notice in lower corners, groups of sea lilies, relatives of modern starfish and sea urchins. These still exist, rooted in the slime of the ocean bed where they can live undisturbed. Palaeozoic animals are now found in extremely isolated localities only.

LATER PALAEOZOIC. This period contained invertebrates belonging to all present day groups which inhabit water, fishes resembling our modern fishes, and amphibians great and small resembling newts, which swam in the water or crawled among the muddy swamps

and on the roots of trees as land emerged from the water. Notice how trees differ from our modern forms, but the tree fern in left hand corner is not unlike certain tropical species. Stagshorn mosses of high moorlands are diminutive descendants of these trees. Trees in right foreground resemble the familiar field and marsh horse-tails. Notice also winged insects which developed with appearance of dry land to fly over and plants on which to alight.

MESOZOIC. (Middle animal). Mainly represented in picture by reptiles, as they flourished particularly at this time, though there were also invertebrates, fishes and amphibia of many kinds. Earth's surface then consisted mainly of ocean, swampy jungle and barren highlands, conditions favourable for reptiles. Seals and whales inhabited the oceans; crocodiles and hippopotamuses crawled in swamps; others roamed the dry land, some herbivorous and many carnivorous. Some smaller forms lived in trees, running and leaping like lizards, or developed batlike wings and flew, the first flying vertebrates. At end of period reptiles lost their importance, owing mainly to their gigantic size, their heavy, hampering armour plating, spines and horns, and their small brain capacity. Note dinosaur triceratops in upper section, stegosaur with crest of triangular spines and long-necked diplodocus (80 ft. from head to tail). Modern representatives of these huge forms are comparatively small, though there are a few of moderate size, such as alligators, boa-constrictors and some turtles. The mammals and birds of the present day owe their existence, not to these giant reptiles, but to insignificant lizardlike creatures. The first birds made

their appearance at end of mesozoic period. Near centre of picture is first known bird, the archaeopteryx (ancient or earliest bird). About the size of a pigeon, it was a true bird, although it had a long tail, feathered to the tip, and claws on its wings and teeth in its beak. Only two specimens have been found, in limestone rocks in Bavaria.

CAINOZOIC. (Period of new animals). The epoch of animals and plants which immediately preceded our own. The climate, which varied much like the climates of our present world, created conditions of life suitable for birds, mammals, every kind of flying insect and plants similar to those of our day. Birch woods and pine forests existed. The chief climatic condition toward the end of the epoch was the alternation of periods of extreme cold with milder periods. Four times at least snow and ice spread over the northern hemisphere, producing great glaciers in Europe and large parts of North America, then receded and again advanced. This period, known as the glacial epoch, occupied thousands of years, and caused great changes in the personnel and distribution of plants and animals, which alternately retreated before the ice and returned to reoccupy the land from which it receded. Animal life is represented in the picture by the mammoth, the Irish elk, the sabre-toothed tiger, and a small ancestor of the present-day horse. Near centre of picture primitive man emerges from his dark cave dwelling—man the hunter, pitting his brain against the speed and caution of the animals, beginning to use his hands not merely to throw missiles on the chance of killing them, but to fashion bone weapons which made his aim more sure

and deadly. The world's story, from the dawn of the life of man, was influenced more and more by his development, as he gradually learnt to dominate his surroundings and modify them to suit his needs.

2. Butterflies. (*Vol. IV., p. 137*). Common British butterflies with distinctive features.

1. *SMALL HEATH*. Pale brick, with narrow dark wing borders and small dark dot near front angle of fore-wing.

Caterpillar green, striped yellow and white. lives on meadow grasses. Meadows and heaths. Succession of broods from April to September.

2. *ORANGE TIP*. Male, caterpillar and chrysalis. White, with orange tip to front wing in male only. Under side of hind wings marbled with green.

Caterpillar green, downy with black specks, on cress and cuckoo flower. Chrysalis greenish yellow and very slender. Common, fields and waysides.

3. *CLOUDED YELLOW*. Male yellow, female cream, with black borders, and one black spot on each fore-wing. Hind wings deepen to an orange centre.

Caterpillar smooth green with yellow stripes and black dots; feeds on small leguminous plants such as trefoil. Chrysalis green with yellow lines. Eastern and southern counties, in the open.

4. *SILVER-WASHED FRITILLARY*. Tawny orange, with black spots and streaks and delicate black scallop pattern on edge of wings. Gleams with silver.

Caterpillar brownish with long stiff bristles, feeds on dog violet, raspberry, nettle and guelder rose, but conceals itself by day. Chrysalis suspended on low plants, brownish with dark spots and stripes and light silver or gold spots on under-side. Woods. Widely distributed but not exactly common.

5. *WALL BROWN*. Tawny brick or dull brown, boldly patterned with brown on fore-wings, small ring in front outer angle of fore-wing, hind wings have two curved bars of brick, outer patterned with small rings.

Caterpillar dark green, slightly striped white and yellow. Feeds on grasses, June and September. Chrysalis dark grey, with dorsal prominence.

6. *RINGLET*. Dusky brown with three small black rings with pale centres on each fore-wing and two on each hind wing. Woodland glades, and bushes.

Caterpillar greyish with reddish down, and dark brown stripe along back, bordered by cream and white. Hibernates, then feeds on seeds and grasses till May or early June. Chrysalis on ground. Shaded brown, with bristles at hind end.

7. *BRIMSTONE*. Butterfly and caterpillar. Sulphur colour, with an orange spot on each wing.

Caterpillar smooth bluish-green. Feeds on buckthorn. Chrysalis green with pale yellow stripes.

8. *PEACOCK*. The name explains itself—colouring suggests eye in peacock's tail feathers. Red brick-orange ground, "eyes" in angles of wings in deep red,

black, lilac and yellow. Fairly common in woods and lanes, and gardens, especially on Michaelmas daisies.

Caterpillar shining black with white dots and black spines. Feeds on nettle and sometimes hop. Chrysalis grey with metallic spots.

9. *RED ADMIRAL*. A close relation of the Peacock, but instead of "eyes" has oblique bars on wings of brick, black and white, on brownish ground. Reddish-brick border to hind wings.

Caterpillar of same spiny type, but dull yellowish-green with yellow spines. Feeds on nettle in July—especially on seeds. Each caterpillar feeds singly, protected by a nettle leaf drawn round it and caught together by a silk thread. Chrysalis greyish-brown with a few metallic spots.

10. *PAINTED LADY*. Wings mottled pale brick on dark (nearly black) ground. Body and base of wings light brown. In August on waste ground, sitting in the sun on flowers.

Caterpillars dark grey with interrupted yellow stripe and short spines. Feeds singly in rolled-up leaves, nettle, mallow and others. Chrysalis brown with light spots and shining golden spots.

11. *LARGE GARDEN WHITE*. Female, chrysalis and caterpillar. Butterfly creamy-white with black margin to fore-wings, and in female, black spots. Yellow under-side.

Caterpillars pale cream and green, with black spots and sparse bristles. Chrysalis pale coloured, with powdering of fine gold dots characteristic of several

other butterflies, which gives the name (*chrysos*—Gk. gold). Should properly be applied only to pupae of butterflies. Note also the spinous projections which hold a silk girdle in place, by which the chrysalis is suspended. Caterpillars feed on cabbages and other cruciferous plants, and garden nasturtium.

12. *COMMON BLUE*. Male butterfly, and under-side. Blue suffused with violet. Under-side delicately spotted grey and tawny. Female brown. Heaths and open country, especially on chalk, but found in other places.

Caterpillar green and yellow, with black spines. Feeds on vetches and other low-growing plants.

13. *WOOD WHITE*. Delicately veined white, with greyish tips to fore-wings. Weak flight. Shady places.

Caterpillar slender, smooth pale green, and pale, slender pupa. Caterpillar feeds on trefoil and vetch.

14. *GREEN-VEINED WHITE*. Larger than garden white butterfly, with more strongly marked veins, and grey border to each fore-wing. A small grey spot in outer angle of each fore-wing, and near front edge of hind wing.

Caterpillar smooth green and white, pupa mottled light brown. Same food as garden white.

15. *SMALL TORTOISESHELL*. Wings deep reddish-orange and brown with squarish spots of yellow, very dark brown, and white forming front border, and small blue crescents bordering the outer edge of the wings which are slightly notched.

Caterpillar and chrysalis dark, the former, which feeds on nettles, having short, sparse bristles and greenish-yellow longitudinal stripes. Closely resembles large tortoiseshell butterfly except in size and in having darker bases to the fore-wings, but caterpillar of large tortoiseshell feeds on elm.

16. *PEARL-BORDERED FRITILLARY*. Like a small edition of the silver-washed butterfly, but without the silver. Common in woods in May and June.

Caterpillar, which feeds on dog violet, is blackish, with bluish-white dots and stripes, and yellow spines on the middle segments.

17. *MEADOW BROWN*. Dusky brown, with tawny patch on fore-wings, in which is a small black ring. Very common.

Caterpillar green, with darker dorsal stripe and cream-coloured lateral ones. Feeds on meadow grass.

3 and 4. Moths. (*Vol. IV.*, pp. 141, 144).

1. *CINNABAR MOTH*. About 1 in. across wing. Fore-wings dark grey with a scarlet stripe along the front margin, and two scarlet spots close to outer edge. Hind wings scarlet.

Caterpillar black and orange, feeds on ragwort, gregariously. Bright warning colours—inedible.

2. *HORNET CLEAR-WING*. Remarkable for its resemblance to a hornet in form, size and colouring, yellow and brown striped, with clear wings bordered by a narrow light brown stripe.

3. *WOOD LEOPARD MOTH*. A moth resembling a hawk-moth, but the wings are not so long or so pointed. (In the hawks the wings are at least twice the length of the body.) Grey body with black spots on thorax and delicate white wings spotted with grey.

Caterpillar white, spotted with black, with black head, burrowing into and feeding on wood of many trees. Pale yellow with scaly black plates on first and last segments, and black spots on head. 2 to 3 in. long when full grown. Pupa large, smooth and brown.

4. *COMMON TIGER MOTH*. One of our most striking moths. Short thick body (about 1 in.) is brown and scarlet with dark bars across. Fore-wings boldly patterned brown and white trellis-work; hind wings scarlet with almost black spots. Wing expanse about 2 in.

The caterpillar is the well-known "woolly bear," with a dark body covered with long brown and black hairs. These can be shot out if the caterpillar is alarmed, and can be very irritating and even cause a rash on the skin, hence children should be warned not to handle them. They walk very rapidly with a rippling movement. The pupa is glossy black, and is enclosed in an off-white, feltlike cocoon, in which most of the caterpillar's hairs, shed as it prepares to pupate, are entangled. Feeds on grass and herbage.

5. *PALE TUSSOCK MOTH*. A soft-looking, moderate sized moth with rounded wings and thick body. Fore-wings pale grey marked with darker wavy lines, hind wings lighter. The "tussocks" are bold tufts of yellow hairs decorating the first four abdominal

segments of the grey caterpillar, which is slender and spotted with red. Wing span of moth under 2 in.

Caterpillar about 1 in. long, feeds on hazel, oak, poplar, fruit trees and hops.

6. *LACKEY MOTH*. An inconspicuous light brown moth, about 1 in. across, with two pale wavy lines parallel to outer edges of fore-wings, dividing them into three equal zones.

Caterpillar greyish, with bright orange-scarlet stripes extending the whole length of the body, separated by a white median dorsal stripe. Very injurious to the leaves of fruit trees. Gregarious, feeding and sheltering inside a silken tent.

7. *VAPOURER MOTH*. The male is reddish-brown with faint dark network on fore-wings, and white spot near outer margin. The female actually has a much larger body, but only vestiges of wings, so that it is inconspicuous.

Caterpillars grey, with orange and white hairs and tubercles, tufts of yellowish-brown hair (yellow in the *smaller* male caterpillars) and a pencil of black hair on first and eleventh, and two on sides of fourth segments. Very conspicuous and handsome. Destructive to leaves of many trees.

8. *OAK EGGAR*. Both caterpillar and moth tawny brown. Large, thick-bodied moth with rounded wings and a ring on each fore-wing. Wings darker near body.

Caterpillar slightly hairy with white dots marking the breathing pores (spiracles). Feeds on blackthorn.

9. *LIME HAWK-MOTH*. All the hawk-moths have long, narrow, pointed wings, hind wings much smaller than front pair, and body ending in a point. Fore-wings of this moth olive-green with pale tips and with two broad bands of mauve-pink, one close to the body, the second nearer the edge and with a deep V indenting its inner margin. Body about 1 in. long, wings about $2\frac{1}{2}$ -3 in. expanse.

Caterpillar bright green with light orange spiracles and oblique lateral bands of yellow and red. A prominent curved spine or horn projects from the end of the body.

10. *PRIVET HAWK-MOTH*. Larger than foregoing, brown, greyish-fawn and pink in colour; hind wings rosy. Wing expanse about 4 in.

Caterpillar of same type as in lime hawk-moth though larger, but with mauve instead of yellow and red stripes. Both named from food of caterpillar.

11. *LAPPET MOTH*. Purplish-brown, the colour of young copper-beech leaves. A large moth with rounded, slightly toothed wings and thick body.

Caterpillar, which feeds on sloe and hawthorn, very large, with fleshy appendages or "lappets." Dark grey or brown, with long tufts of hairs at sides, and a very large black tuft on next to last segment.

12. *GOAT MOTH*. Moth ashy grey, with rounded wings and thick body.

Caterpillar destructive, large, almost smooth, light chocolate-brown on back, pale yellowish-fawn below, with black head and spot behind head. Feeds in wood of trees like leopard moth, especially willow and poplar.

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Pupa golden to dark chocolate-brown, smooth, but with reflexed hooks, enclosed in a cocoon roughly made of chips of wood gummed together, and lined with silk. The hooks help it to escape from the tree. Name due to strong smell of caterpillar.

13. *BROAD-BORDERED FIVE-SPOT BURNET.*

A small moth with dark bluish-green fore-wings each with five scarlet spots, which however are usually confluent, making three apparently. Hind wings much smaller, scarlet edged with dark grey. Wing expanse about 1 in., wings narrow. Marshy places.

Caterpillar green with white and yellowish stripes, feeds on trefoil, vetch and other low plants.

14. *NARROW-BORDERED BEE HAWK-MOTH.*

At first sight closely resembles a bumble-bee in size and shape of body and wings. Wings bordered with light brown. Mouth-parts and antennae, in both this moth and the hornet clearwing moth, would, however, at once indicate to an observer that these are moths, for they have the coiled "tongue" between short feathered "palps" or tasting organs, and the slightly feathered antennae of a moth. Flowery meadows near woods, in May. Quicker and more sudden flight than bees.

Caterpillar bluish-green with lighter marking, and white lines dotted with red. Scabious, honeysuckle.

15. *EMPEROR MOTH.* The peacock eyes on all four wings are the distinguishing marks of this moth, which has purplish-brown front wings, and paler, more reddish hind wings. A dark bar extends along the

wings close to the outer edge. The short antennae are conspicuously plumed.

16. *DRINKER MOTH*. Moth cream to tawny yellow ochre, downy. Wing expanse about 2 in.

Caterpillar rather resembles a "woolly bear" at first glance, but the hairs are not so long, the general impression of the colour is light brown, due to the hairs, though the body is slaty-blue. Two pencils or tufts of light hairs project from the back, one near the front and one near the hind end of the body. A light-coloured, silken cocoon is made. Feeds on grass.

17. *DECEMBER MOTH*. A softly-coloured moth with brown body and lighter grey wings. Wing expanse about $1\frac{1}{4}$ in. Hind wings lighter than front. Narrow yellowish-buff stripes parallel to outer edge of wings. Appears October-December.

Caterpillar feeds on trees, and is gaily coloured with white and red spots, broken orange stripes, and black and grey hairs.

18. *GOLD-TAIL*. White with abdomen tipped gold. About 1 in. wing-span.

Caterpillar brightly-coloured on black, with delicate tufts of long hairs on fourth and eleventh segments. A broken white median line along the back separates two broken red bands bordered with black. Feeds on fruit trees and others.

19. *LARGE WHITE PLUME MOTH*. Actually only a small moth, though the largest of the "plumes." Each wing is divided into narrow segments, so that

there appear to be five white plumes on each side of the body. Legs also long, delicate and trailing, adding to feathery effect. Very dainty little moths.

20. *EARLY GREY MOTH*. Pale grey with yellowish hind wings and a row of dark pear-shaped spots bordering fore-wings. $1\frac{1}{4}$ in. across wings. Appears March-April.

Caterpillar feeds on honeysuckle, but hides during day.

21. *COMMON YELLOW UNDER-WING*. Brownish grey to dark brown, with body projecting well behind wings. Hind or under-wings bright yellow ochre with black marginal bands. About 2 in.

22. *CABBAGE MOTH*. An inconspicuous greyish moth with yellowish markings. $1\frac{1}{2}$ in.

Caterpillar smooth, green or greyish, with faint oblique stripes on sides.

23. *SWALLOW-TAILED MOTH*. Pale yellow, with hind wings drawn out into points.

Caterpillar well-known because of its resemblance to a small leafless twig, slender, stiff, and dull brownish-grey. Various trees and bushes; e.g. sloe, elder, honeysuckle.

Caterpillar hibernates.

24. *GREY DAGGER MOTH*. A pale grey moth, fore-wings darker, with grey marks pointing from edge to body, something like daggers with very wide cross-pieces.

Caterpillar on fruit trees and others.

25. *WINTER MOTH*. Destructive to fruit trees. Light fawn with slightly darker shading. Female has only vestiges of wings, and has to crawl up to lay eggs, hence the use of grease-bands, but it is said that males have been known to carry females and so defeat the object of the band. Eggs laid on trees in late autumn hatch in March.

Caterpillars feed on leaves. They are green or brown, with a dark line along the back, and three whitish ones on each side.

26. *BUFF TIP MOTH*. Front wings pale grey with dark wavy streaks and prominent yellow-buff tips. Hind wings and hind part of body cream; front part buff and orange. Wing expanse $2\frac{1}{4}$ – $2\frac{1}{2}$ in.

Caterpillar mostly on elm.

27. *PUSS MOTH*. Large, pale grey, downy, with darker spots and streaks.

Caterpillar unique: large thorax broadens to a peak on dorsal side of abdomen, which then narrows to a point adorned with two streamers. Under parts bright green, dorsal parts grey. A broad pigment patch spreads over front part of body, and laterally into a "saddle." A bright red and orange "face" is really the front part of the thorax. The curious form, "face," and terrorising attitude adopted are said to be a protection against the enemies of this quite harmless creature.

28. *RED UNDERWING*. A large moth (3– $3\frac{1}{2}$ in.) with wings extending to level of end of body. Forewings

grey, with wavy dark lines, hind wings vivid crimson with broad black border and narrower curved black inner band.

29. *PEPPER AND SALT MOTH*. Handsome dark and light grey moth, with distinctive wavy markings all over wings, fairly equally distributed and evenly patterned.

30. *COMMON ERMINE MOTH*. Small, slender, with narrow wings which lie very close to body when at rest. Fore-wings white, finely dotted with black. Hind wings fawn or greyish.

Caterpillars are responsible for webs often covering privet and other bushes, inside which they live gregariously while they strip the leaves. There are several slightly different ermine moths.

31. *COMMON CARPET MOTH*. A slender grey and brown moth, about 1 in., marked with fine dark lines parallel to edge of wings, and one white bar on the fore-wings. Suggests some of the old-fashioned Brussels carpet patterns.

32. *DARK BROCADE MOTH*. Short body. Front wings dusky brown, with darker spot, almost square, near hind margin and zigzag line bordering margin, and other dark markings, all edged with yellowish-fawn. Hind wings grey, shaded darker.

33. *COMMON SHARK MOTH*. In shape rather like the hawk moths—long, pointed body and pointed

grey fore-wings, with much smaller, clearly veined yellowish-grey hind wings. About 2 in.

34. *BRINDLED BEAUTY* Brown and grey, with brindled markings; i.e., faint spots and well-marked dark lines, following the shape of the wings. Short body. Female paler.

Caterpillar a "looper" or "geometer" (earth-measurer), reddish-brown and purplish-brown, striped longitudinally, the stripes separated by fine black lines, small yellow spots on back, and narrow yellow band behind head. Feeds on oak, birch and other trees, including fruit trees. Very plentiful in London squares.

35. *MAGPIE MOTH*. Also called currant or gooseberry moth. One of the best known to gardeners for the depredations of the caterpillar on fruit bushes, and on the ornamental evergreen *Japanese euonymus*. Moth cream, with black and yellow spots and streaks, very variable in quantity and depth of colour.

Caterpillar same colouring, black spots on back and yellow longitudinal stripe above legs on each side. Swings from twig to twig on fine thread. Pupa shining black with yellow bands—no cocoon.

36. *HERALD MOTH*. Fore-wings reddish-grey to reddish-flesh colour at margin, with a broad triangular reddish-orange band, narrowing to the thorax, and marked with light and dark grey and orange and white dots, the colouring and design faintly suggesting a herald's garb. Margin, deeply notched behind front angle. Hind wings pale grey. On the wing in August

and September. Hibernates and then reappears from March to June, and is common.

Caterpillar green and velvety, striped dark green, and yellow or white. Feeds on willow and poplar.

5. Diagram of Hen's Egg. (*Vol. II., p. 35.*) A hen's egg in section, giving a clear idea of its composition. The "germ" or embryo chick, seen at the top, appears as a white spot in a raw egg. This germ consists of protoplasm, and it is this alone that gives rise to the chick.

The yolk, enclosed with the "germ" in a thin membrane, is the food supply. Yolk and "germ" are suspended in the albumen, in which they float, by a twisted rope of albumen (chalaza) attached as the egg is passing slowly, with a spiral movement, down the oviduct or egg passage. Lower down, the shell is added in the same way. The albumen serves as a water bath to protect the embryo from shock, violent contact or undue pressure. It swings as a boat at its moorings, only it is moored at both ends. The albumen is not a food supply, except just at the end of incubation. Compare it with the jelly surrounding a frog's eggs or a water snail's eggs, serving the same purpose.

6. Rabbit's Skull and View of Upper Jaw. (*Vol. II., p. 37.*) The following characteristic points should be noted when studying the skull of a rabbit.

The lower jaw is hinged far back, below and behind the eye socket, to an arch of bone attached to the skull. The skull proper, or cranium, is the bony case which encloses the brain. It has free movement up and down, upon the rigidly fixed upper jaw.

At the front of each jaw is a pair of straight-edged,

sharp teeth for biting or gnawing (incisors). A smaller pair of incisors lies behind those in the upper jaw. This is peculiar to the rabbit. The incisors meet one another. The enamel covering the front of the teeth is thicker than the rest and is worn away less rapidly, the teeth being therefore worn to a chisel edge; this is bevelled on the inner surface of the edge. Note the value in cutting wood and hard substances.

A gap separates the incisors from the cheek teeth to help the lips and tongue in drawing food into the mouth. Compare other herbivore, especially the horse.

The cheek teeth grind and break up the food; hence the name, grinders or molars. They have a grooved edge and a rectangular, grooved biting surface, and as they lie close together the result is a series of ridges which work upon one another to grind up the food. There are six in each upper jaw and five in each lower jaw. The teeth grow continuously from the roots to make up for the loss by wearing. Occasionally a rabbit has a tooth broken and then the opposite tooth goes on growing. This has been known to grow into the jaw so that the mouth was closed and the animal died of starvation.

The useful chisel edge to the incisors and broad grinding surface to the molar teeth are found in all herbivorous animals, though they are quite unrelated. In a horse the crown of the molars is worn down so that a pattern of curved ridges of enamel forms the hard grinding surface, the hollows being filled with the softer dentine which forms the inside of teeth.

7. Dog's Skull—Side and Front. (*Vol. II., p. 40.*)

A typical carnivorous animal, the dog. Particular characteristics to note are:—the breadth and strength of

the lower jaw, the small incisors—six in each jaw—the well-developed molars—six above and seven below at each side—and between the molars and incisors at each side, the large, conical, pointed canine tooth which is most useful both for holding and tearing flesh. The molars are strong and broad, each provided with three or four pointed prongs or cusps. It is usual to distinguish between molars and premolars. Premolars occupy the position of similar teeth belonging to the first, or milk dentition; molars are further back in the jaw and are developed only in the second or permanent dentition.

The two most important types of carnivore are represented by the cat and the dog. Wolves, foxes and jackals are of the dog tribe; lions, tigers, leopards and panthers are great cats. The cats are more subtle in their methods of hunting and attacking than the dogs. Cats use their claws as well as their teeth in attacking their prey, and these very formidable weapons are kept sharp by being retracted into a sheath when not in use. Since the teeth are not quite so important as a dog's in retaining a grip of the live prey, a cat's jaws are shorter, its teeth smaller in proportion and fewer in number—four molars at each side in the upper jaw, three in the lower.

8. Skeleton of Rabbit to show Limbs. (*Vol. II., p. 163.*)

The structural plan of the rabbit is typical of the similarity existing among the limbs of frogs, reptiles of the lizard type, and mammals such as the dog and man, or the insect feeders, as the mole and hedgehog.

Limbs. The front limbs consist of three main parts, upper arm, forearm and hand or front foot. They are

shorter, slighter and straighter than the hind as there is less weight to carry and less movement. A rabbit springs by sharply bending and then straightening its hind legs, landing with them bent again. It gets a take-off from the spring board of its long feet, and lands on their whole length when it comes to rest again.

The front feet of mammals are used for scratching, holding and grasping and need therefore to be movable both at the wrist and between the shorter joints. Mobility is brought about by the whole limb being fitted into a socket by the rounded end of the upper arm bone (ball-and-socket joint). The hip joint is the same, but the socket is deeper, to prevent slipping, on account of the extra strain to which it is subjected. Note the two bones of the forearm are projecting at the elbow and also the small bones of the wrist firmly wedged together.

The hand consists of four or five bones, to which the fingers are joined. Each finger has three joints. If the first finger, or thumb in ourselves, is present, it has only two joints.

The hind leg has the same plan as the front, but every part is stronger. There are fewer ankle bones than wrist bones, and less play at the ankle, in order to take the heavy weight of the body.

Framework. The curved chain of small bones (vertebrae) supports the back. Notable items are the spines projecting backwards and sideways to support the muscles of the back and sides which control movements. The breast or pectoral girdle should also be noticed, consisting of two large, triangular bones at

the back (shoulder blades), and the breastbone in front. These give a firm base for the work of the limbs.

In man and other climbing animals an extra pair of bars, called collar bones, strengthen the girdle in front to take the weight of his body when swinging from a branch or rope.

The hip or pelvic girdle is also joined to the trunk bones to support the legs and take the weight of the body. In this region the chain bones are broadened out and joined together to give still greater firmness.

In the front part of the body a number of slender, curved bones, the ribs, also join with the chain bones or the breastbone, forming a protective cage for the heart and lungs and making the body more rigid.

The majority of mammals walk upon their toes. Thus, the foot and leg bones have been lengthened, and some have disappeared, or become fused together, to give greater rigidity, and therefore both support the body better and give greater speed.

The rabbit supports itself on its front toes and hind feet when resting, but the long hind foot is always ready to be used as a spring board. A sudden bend of the knee joint, and a spring from the foot send it leaping away at the slightest alarm. The front feet just take the weight between the springs.

9. Hind and Front Feet of Horse to show lengthening of Foot and "Hand" Bones. (*Vol. II., p. 47.*) The horse is a good example of rigidity and fleetness going together. Each long foot consists of only one toe, and one hand or foot bone with a pair of splint bones, representing hand or foot bones which have disappeared. Fossil ancestors of the horse have been found

in which both three, four and five well-developed toes were present. It seems that the earliest ancestors of the horse dwelt on marshy ground where a splaying foot would be useful in preventing it from sinking into the soft, wet soil, but as thousands of years passed and the land became drier, animals arose in which the five toes gave place to the smaller number, the toes became thicker, and the whole leg and foot more columnlike and rigid. The ostrich is an example of a bird in which the toes have been reduced to one, again in connection with the power of swift running over firm ground.

10. Skeleton of Man. (*Vol. II., p. 365.*) An understanding of the functions of the human skeleton is of considerable practical value, the main principles of the general structure being clearly outlined in the picture.

Notable points.

(a) The skeleton serves a number of purposes: (1) it supports the body; (2) it protects the body; (3) it gives shape to the body; (4) it enables the body to move.

(b) The joints show a number of differences in their functions. Note the hinge joints and the ball-and-socket joints. For example, the top thumb joint and top finger joints are hinge joints, while the shoulder and hip joints are ball-and-socket joints. The pivot joint at the elbow serves the purpose of turning over the hand. There are some immovable joints in the body too—such as in the upper jaw and cranium.

(c) The bones, mainly composed of lime, are not solid throughout, but consist partly of a spongy tissue with air spaces. This gives elasticity and lightness.

In the hollow middle of "long bones," such as thigh or arm bones, is the marrow, generally associated with the manufacture of the red corpuscles of the blood. This is an example of the body's neat, economical packing. In the first place, the "long bones" such as the thigh, shin and upper arm bones, are more resilient and elastic to withstand shocks. In the second place, the body makes use of the hollow cavities running down the centre of the bones, and red blood corpuscles are manufactured there.

The repetition of the ribs and the vertebrae show also that Man has evolved from far back ancestors in which this repetition of segments occurred. The earth-worm is one living example among many of such a body plan.

With this picture, reference should also be made to Class Picture No. 9.

11. Organs of the Body of Man (*Vol. II., p. 371*), illustrating the position and relative sizes of the main organs in the body. Notice the position of the lungs—the right lung is larger than the left lung on account of the heart which is on the left side on the body. Oxygen, which is necessary for life is taken in with the air we breathe, fills the lungs, and then passes into the blood stream which conveys it round the body to the muscles. The organs of the chest are protected from outward assault by the ribs, and they are separated from the abdominal organs by a strong mushroom-shaped muscle called the diaphragm. Of the abdominal organs, there are three chief divisions—the stomach, the liver and the intestines, small and large. Nature's economy is well illustrated by the packing into the

abdomen of some twenty-five feet of intestine; while if the inner surface of the lungs were spread out it would cover over half a tennis court.

12. Pond Insects. (*Suitable for lecturette, see Vol. I., p. 31.*)

1. **STONEFLY.** 1a. larva. Very similar to a caddis fly, but yellowish-brown in colour, and to be distinguished by its habit of sitting on stones. More sluggish, flying slowly and heavily, has markedly narrow front wings and a pair of projections from the last segment. The larva has a squarish head, and can be distinguished from an alder fly larva by the absence of abdominal tracheal gills and by the two projections (instead of one tracheal gill) in the last segment. It has very small tracheal gill tufts on the thorax and a small pair on the last segment. It crawls about on the bottom, especially under stones, though it can also swim.

(Tracheal gills are breathing organs so called from connection with breathing tubes or tracheals.)

2. **SQUAT-BODIED DRAGONFLY, LIBELLULA.** 2a. larva with wing rudiments, usually called a nymph. Eggs are laid singly on water plants by means of an ovipositor or egg-laying apparatus like a hypodermic needle. Larval life is spent under water, breathing by means of thin-walled pouches in the hinder end of the food canal. Water is sucked into this tube—the rectum—and dissolved oxygen withdrawn by these pouches. The larva is an ugly, drab, slow-moving creature, short and clumsy, covered with coarse hair to which mud and filamentous weeds become attached,

affording it additional concealment. Like all dragonfly larvae, it is carnivorous and obtains its victim by shooting out its jaws, which form a "mask" under the head. There is no pupal stage, but the skin is shed several times, and in the later stages the wings appear, growing larger with each moult. The fully grown nymph crawls up a stem out of the water, and splitting its skin for the last time emerges as the dragonfly.

3. *ALDERFLY*. 3a. larva. A dusky fly with long antennae and four wings, the front ones folded over the hind ones while at rest. Antennae shorter than in the caddis fly. The body is also shorter, the hind wings more rounded, and the flight heavier. The larva may be distinguished from a mayfly larva, which it somewhat resembles, by the long single projection at the hind end, and by the longer lateral tracheal gills, sloping backwards. Eggs are laid on a solid object some distance from water, to which the larvae make their way on hatching.

4. *CORETHRA*, a gnatlike fly, and 4a., its larva, called the "phantom larva" because of its transparency, which makes it almost invisible. The most conspicuous features are two pairs of dilations or sacs, each with a black pigment spot. One pair lies behind the head and the other near the end of the body, serving probably as floats. There is something uncanny about the insects' appearance as they shoot, or jerk, through the water, visible while in movement but difficult to see when at rest. A row of stiff hairs on the last segment forms a kind of fin, while the head bears a prominent black eye spot, well-marked antennae and jaws. The

antennae are used for seizing the prey. The pupa closely resembles that of a gnat and floats at the surface, breathing by means of short funnels.

5. *POND SKATER*. A slender water bug adapted for skimming over the surface film. A long beaklike pair of jaws forms a sucking tube, while the front legs are modified to catch and hold insects (cf. corethra larva). The first segment of the thorax is long, so that the first pair of legs lies some distance from the second pair, which carry out the skating movement. The third pair acts as steering gear. It feeds on both living and dead insects. There is direct development, that is, no true larval stage, the young being structurally like their parents, as well as resembling them in habits. Very common.

6. *WHIRLIGIG BEETLE*. 6a. larva. A very common blue-black beetle, with short club-shaped antennae, occurring in large numbers at the surface of ponds. The name describes the movement, which is the most striking feature. The larva swims in a serpentine manner. Both stages are carnivorous, but the adult also feeds on water plants, using the front legs for grasping food. The larva, extremely difficult to find, is said to leave the water and pupate among plants in a silk cocoon. The beetles hibernate on the bottom of a pond, an interesting feature, as they are atmospheric air breathers. The larvae breathe under water by means of a double fringe of tracheal gills, shown clearly in the picture.

7. *WATER SCORPION*. Another of the water bugs, with the characteristic sucking beak and prehensile

front legs used for catching and holding food. Partly carnivorous, partly a scavenger, like most of the water bugs. It has a dark, ashen-brown, flattened body with two projections at hinder end fitting closely together to form a breathing tube, the tip of which is projected above the surface to take in air. Direct development as in all bugs.

8. *THE WATER BOATMAN, NOTONECTA*. Another bug, which swims on its back, the dorsal surface forming a keel. Front legs project like antennae, and are prehensile, the third pair, fringed with hairs, form oars. Notice the piercing beak, and large eyes.

9. *CORIXA*. Very similar to Notonecta, but much smaller, and swims with back uppermost. Hind end more rounded. Young ones will frequently be found in any catch from a pond. These are cream in colour, with red eyes. The colour gradually darkens with each moult. Adult and young both breathe at the surface by drawing air into pores at the tip of the abdomen, which is projected slightly.

10. *GREAT WATER BEETLE, DYTICUS*. 10a. female, 10b. larva. One of the largest and most ferocious pond dwellers. The female has grooved wing-covers, and the male has enlarged joints on the front legs. All these forms take in air at the tip of the abdomen by projecting it above the surface, and the larva is provided with fringed appendages which it presses against the surface film to keep it afloat. The adult beetles fill the space under the wing covers with air.

Breathing pores then open and draw the air into the tracheae. The larva may be recognised by its "S" shape when suspended in the water and by the broad flat head with slender, curved, pinching jaws and small eye spots at the anterior angles.

11. *LONG-BODIED DRAGONFLY, AESCHINA*. One of the kind commonly called "horse stingers" or "devil's darning needles." None of the dragonflies can sting, but all feed on insects on the wing, and are ferocious and swift in attacking their victims. The larva is a clear bright green which darkens as the time of metamorphosis to the adult stage draws near. Life history and breathing similar to the Libellulids. The wings in both are broad at the base.

12. *DEMOISELLE DRAGONFLY*. One of the small, slender, brightly coloured forms. Wings narrow at the base. 12a. larva, pale green, changing to fawn in the nymph. Breathes by three delicate leaf-like gills on the last segment.

13. *GNAT*. Female, 13a. larva, 13b. pupa. The male can be distinguished by its feathered antennae, and both from the harlequin fly, by their attitude at rest, with hind legs tilted up. Only the female bites and buzzes. The larva, common in stagnant water, swims by jerks and breathes by means of a tube on the eighth segment. The tip of this tube can be projected above the surface film, while at the same time a circlet of small valves opens and spreads out, making a slight air cup whereby the insect is suspended. On closing the valves over the end of the tube again, the surface

tension is removed and the larva sinks. To rise again, jerks of the whole body are assisted by a special organ projecting from the last segment. The larva floats head downward, but the pupa floats head uppermost. Its enormous "head," furnished with a pair of breathing tubes (cf. pupa of corethra) really comprises thorax and developing wings as well. In both corethra and gnat the pupa remains active and moves about, though it does not feed.

14. *CADDIS FLY*. 14a. so-called "caddis worm," the larva which spends its life in water. Many different species of these insects exist, each characterised in its larval stage by a case made of distinctive material taken from the water. Eggs are dropped as the female adult skims with weak flight across the surface of a pond, ditch or stream. They hatch into minute larvae, which begin to construct a case by attaching bits of sand, stick, leaf, or minute snail shells to the body, gluing them together with a secretion. Inside this case the larva is protected from its enemies. Small hooks on the last segment fix it into its case. It can project the anterior part of its body, which has a horny covering, but keeps the soft hinder part inside. Feeding on small animals or plants, the larva reaches a passive pupal stage, spent in its case, from which it emerges as a fully fledged "fly." During the pupal stage each opening of the case is closed by a net of fine threads which enable a current of water to pass through so that breathing can go on unhindered.

15. *MAYFLY*. 15a. Green Drake, 15b. larva. Mayflies usually swarm in large numbers when they appear,

and their dancing flight is very characteristic. Long styles trail from the last segment, the slender front legs project like antennae, and their whole appearance is frail and light. The "green drake" is the stage preceding the last, unique amongst insects in that the skin is shed in the winged state. The green drakes leave the water, settle on trees, fences and telegraph posts, and the skin, splitting, allows the adult fly to emerge. This is more slender and delicate. The larva usually burrows in mud and conceals itself in a little tunnel, though it can swim. It has prominent, quivering, tracheal gills of leaf-like shape on each side of the abdomen. These long projections from the end of the abdomen are gills connected with the blood system. In all cases where gills are found, they consist of delicate membranes, through which dissolved oxygen can be extracted from the water. The larva is greenish and transparent, but as it changes to the nymph stage and the wings appear it grows darker and more opaque with each moult.

16. *HARLEQUIN FLY*. 16a. larva, 16b. pupa. A gnat-like midge which dances on window panes and comes to rest with its *front* legs in the air (cf. true gnat). As in the gnat, the male has bushy antennae, the female much sparser ones. The larva is known as the blood-worm owing to its bright red colour, and swims with a figure 8 movement in water butts and other stagnant water. It breathes by gill tufts on the two segments, and its red blood is able to take up oxygen, a great help in stagnant water and mud, into which it burrows when not disturbed. (A species which lives at the surface is without the red colour and in very young larvae it is

not developed.) The pupa is similar to that of a gnat and though able to move is much less active. It breathes by white tufts projecting from the front of the thorax—not, as in the gnat, by funnels projecting above the water. The “head” of the pupa is narrower than that of the gnat pupa.

17. *DRONE FLY*. 17a. larva, called the rat-tailed maggot. Drone flies are large and heavy-looking, resembling bees. Some are black, some banded brown and yellow. They are quite harmless, and feed on pollen and honey. They lay their eggs in putrid water—manure tanks, ponds and ditches frequented by cattle. The larva is a dingy white creature, blind and legless, though seven pairs of hooked stumps enable it to crawl. It creeps over mud and feeds on decaying organic matter, having an elaborate suction pump in its throat. An extraordinary telescopic tail, capable of being extended to 4 or 5 inches, enables it to keep contact with the air while creeping in the foul water, for the tip can be projected above the surface film, and a circlet of bristles, which when closed form valves over the end of the breathing tubes, open out to allow air to enter. Pores at the tip lead into two air tubes which pass down the tail to the main tracheal system of the body.

18. *CHINA MARK MOTH*. 18a. caterpillar. Small moths with the unusual habit of passing the larval stage in water. The caterpillar of the Small China Mark makes itself a small case of duckweed and lives inside it, while the Brown China Mark cuts out two oval pieces from large leaves and binds them together with silk. They live at the surface of the

water, and enclose air in the case so that they are dry and able to breathe. They are very common and may easily be mistaken for species of caddis worms, particularly those in the duckweed cases.

19. *THE CHAMELEON FLY*. 19a. larva. A large black and yellow banded fly, resembling a bee, but at rest the wings cross over the abdomen. Feeds on nectar. Eggs laid on the underside of leaves of water plants, a little above the water. The larva makes its way to the water, where it floats at the surface, head downward. It has a spindle-shaped body tapering to the hind end, but its most striking feature is the perfect shallow cup of delicate hairs surrounding the air aperture at the tip of the abdomen leading into the tube. This circlet encloses air below the water and the surface tension between the surface film and the hairs supports the little creature. It not only breathes but feeds in this position on microscopic organisms as they drift past. If alarmed, it closes the hairs together as with an umbrella and sinks, diving downwards by wriggling movements. It floats to the surface again and resumes its normal position as soon as it stops its active movements. The pupal stage is curious, in that the pupa, much shrunken, is enclosed in a small cocoon inside the larval skin. This may either float in the water or the larva may first crawl out of the water to some retired spot. The fly emerges and stands on the surface film while it dries and expands, the hairy surface preventing it from getting wet.

13. Helpful Insects. (*Vol. IV., p. 146.*) The insects in this plate and the next illustrate the wide range of

habit, size and type to be found among the vast numbers that come into contact with man's life. A small proportion of these may be regarded as helpful as shown in the appended notes.

1. *HONEY BEE*. Worker, queen, drone and larva. Honey or hive bees have a highly organised society: the queen concentrates on egg laying, while the workers perform all other duties of the hive—gather pollen and nectar for bee bread and honey, make wax by means of glands in the abdomen, model the cells which make the comb, clean and attend to the larvae. Incidentally, in collecting honey and pollen, they bring about cross-pollination of flowers, securing the vigour of stocks and, in many cases, the survival of the breed, since many flowers can receive pollen only from other flowers. Apart from cereals, the greater part of all our crops depends upon the activity of bees and other insects to produce their seed.

2. *LADYBIRD*. Adult, larva and pupa. Many distinct species of this small beetle exist. All, both as larvae and adults, feed upon aphides (green fly and allies). Larva black with yellow spots. Moults skin several times, then changes into short, thick, black and yellow pupa, which is quiescent for some time. Finally, adult beetle emerges. Hibernates under loose bark or amongst evergreens such as box, often large numbers together.

3. *GROUND BEETLE*. These beetles run about the ground and have lost the power of flight which most beetles possess. They are carnivorous, both in the

larval and adult stage, and thus rid the soil of many noxious insects, slugs and snails. They have thread-like antennae. (The form of antennae is used in classifying beetles.)

4. *GREEN TIGER BEETLE*. Both stages feed on insects voraciously, the adult roaming in search of them, but the larva digging itself a pit, which may be a foot deep, waiting at the top for its victims, which it draws into the burrow to devour. Note the bent form of the larva, the broad, hard head (said to be used like a bricklayer's hod, for carrying earth up from the burrow and throwing it out) and the hooks on the abdomen which seem to help it to grip the sides of the burrow, like the earthworm's bristles. The adult has threadlike "horns" and a rather rectangular body.

5. *LACE-WING FLY*. Fly, larva and pupa, and eggs attached to a lime leaf by slender stalks. Adult transparent, and eggs so small that they are often overlooked, though fairly common. Greenish, with golden eyes. Four wings. Attracted by lights to houses, like moths. Larvae light brown, bristly, and often covered with remains of skins of aphides they have eaten, for larvae and adults both feed on these.

6. *HOVER FLY*. Various species. The one illustrated is banded with black and yellow, the warning colours usually associated with a sting. They have no sting, however; this is supposed to be a case of protective mimicry, the colour resemblance to a wasp

giving a defence against birds. They differ from wasps and bees in having only one pair of wings, and in not having the abdomen constricted just behind the thorax to form a "waist." The hovering movement is produced by very quick beating of the wings, enabling them to stay in one position for several seconds. The adults feed on pollen, and are particularly fond of Michaelmas daisies. They help in fertilising flowers, but their great service to man is performed by the larvae, which feed voraciously on greenfly and other aphides. The larva (grub or maggot) has a large, swollen, almost transparent body and small head, so that it suggests a sack being dragged along by a dwarf. The pupa might be mistaken for a very small slug, greyish-brown in colour and lightly striped, usually in a humped-up position between leaves. Both maggots and pupae may hibernate amongst dead leaves. It is said that one larva will kill nearly one thousand aphides during that stage of its life.

7. *DRAGONFLY*. The dragonfly figured here is *Callopteryx* sp. Like all the dragonflies, in the adult stage this insect feeds on the wing, on flies chiefly, and therefore helps to keep down the numbers of these injurious insects, many of them disease carriers. It is important to note that dragonflies are harmless as well as valuable, because many are killed under the impression that they are "horse-stingers." They have no sting.

8. *CHALCID FLY*. These are minute parasitic insects, closely related to the ichneumons and similar in habits. There are many of them; some attack wasps, some moths, and a few attack plants. Frequently they

are of brilliant metallic colouring. It should be noted that very minute insects *may* be useful, and should therefore not be killed without further inquiry. The one figured, *Encassia formosa*, attacks and controls greenhouse white fly, and is therefore of great value to nursery gardeners.

9. *BURYING BEETLE*. A useful scavenger, helping to bury the bodies of rats, mice, birds, and other small animals, upon which it feeds after digging away the ground from under them until they sink and are covered by the soil. Incidentally, the parts which the beetles do *not* devour eventually enrich the soil with nitrates. There are many different burying beetles. Club-horned.

10. *BRACONID FLY*. These again are minute forms related to the *Chalcids* and *Ichneumons*, and of similar habit. The one figured is a parasite on the cabbage white caterpillar. Its larva lives inside the caterpillar, emerging to pupate when the caterpillar also is just ready for pupation. The host thus lives as long as the braconid needs it, one of nature's marvels. The pupae are enclosed in small, cylindrical cocoons of yellow silk. The "flies" are black, and waisted. Another braconid, fairly common as a parasite inside magpie moth caterpillars (destroyers of currant and gooseberry leaves), causes a distorted black and white (instead of black and yellow) pupa to be formed, from which no moth emerges.

11. *ICHNEUMON FLY*. There are many ichneumon flies, some very small, some large. They belong to the same order of insects as the bees and wasps, and have

four wings and a narrow waist. Their general habit is to lay eggs inside the body of some other insect, in the larval stage or even in the egg; the grub lives parasitically, keeping pace with its host, and eventually kills it, when the parasite is ready to pupate. The ichneumon figured is a species of *Rhyssa*, which attacks the larva of one of the wood-boring wasps, *Sirex*. Since these larvae cause very great damage to pine wood, the parasite *Rhyssa* is of assistance to the owners of forest trees. The adult female *Rhyssa* searches over the surface of a tree trunk, and possibly by smell, detects the presence, deep inside, of a *Sirex* grub. She then bores down with her needlelike ovipositor (egg tube) and deposits an egg close up to the grub. The egg hatches and lives, in this case, as an *external* parasite on the *Sirex*, eventually killing it.

12. *ICHNEUMON* (*Limneria gracilis*). This lays its eggs on the larvae of the diamond back moth which attacks turnips, and is therefore useful in checking its spread.

13. *GLOW WORM*. Male and female. These are chiefly known because the female beetle carries a light to attract the plain brown males, but they are useful because the larvae feed on small snails. The adult beetle is only about $\frac{1}{3}$ in. long, with serrate (saw edged) "horns." Under the tip of the abdomen the female (and to a very slight extent the male) produces a phosphorescent substance which gives a bright, soft greenish light. Active, especially on still, warm nights from early dusk onwards; on damp, grassy banks. The light is intermittent.

14. *HORNET*. Of similar habits to the wasp, the hornet is much larger, handsomer, and more terrifying in appearance. Its sting can be dangerous, but undoubtedly on the whole, like the common wasp, it is valuable in keeping down caterpillars which would injure crops.

15. *WASP*. The common wasp, not generally held in high regard, undoubtedly pays its way by killing large numbers of caterpillars. It is true that wasps take heavy toll of fruit, but doubtful if they can gain entrance if perfectly sound. Usually they feed on fruit which has been pecked by birds. However, their usefulness depends on their numbers being strictly limited particularly in seasons which are favourable to them. Caterpillars and other insects are stored as food for the larvae.

16. "*SOLDIERS AND SAILORS*." Bright red and blue ground-dwelling beetles feeding on larvae, slugs, earthworms.

17. *DEVIL'S COACH HORSE*. Another carnivorous beetle which helps to keep down insects in the soil. As many insects (such as the turnip fly) which attack plants spend part of their time in soil, the various carnivorous beetles are of high value to the gardener and farmer. Another name for the devil's coach horse is the rove beetle from its roving habits. It is rather primitive, and its narrow shape suggests a larva rather than an adult beetle, especially as the very short wing cases (*elytra*) expose more of the body than is usual and so show the segmentation. The abdomen is supple, and frequently tilted up, thus

giving it yet another popular name, the cock-tail beetle. It is dull, sooty black, and very jaunty-looking. Its "horns" or antennae are clubbed. The underground larva is not nearly so frequently seen as the adult.

Although many beetles are of great value to farmers and gardeners others are injurious to crops. It is therefore of importance to be able to distinguish as many as possible, both in the larval stage and the adult. The larvae of beetles are long and segmented, with sharp, curved jaws for biting, and a flat head. They may be active, if they are carnivorous, or very sluggish if they need only to crawl slowly in search of plant food, but not all active larvae are beneficial or *vice versa*.

14. Harmful Insects. (*Vol. IV., p. 150.*) Every order of insects contributes to the list of those which may be dangerous, but Colcoptera (beetles), Hymenoptera (sawflies and gall midges), Lepidoptera (butterflies and moths), and Diptera (two-winged flies) probably contain the largest number of man's enemies.

1. *HOUSE FLY.* Belongs to the *Diptera*, or two-winged flies, which have the second pair of wings reduced to knobs, yet have a very highly developed power of flight and of balancing. Members of the order have varied feeding habits, some sucking nectar (e.g., hover flies), some sucking the blood of animals (e.g., stable flies, gad flies, tsetse fly), some living on carrion and refuse. They all have short, awl-shaped larvae with no legs or eyes, usually finding their food by smell. In the house fly these are white. The eggs are laid in damp dust and refuse, hatch in about two days, and in six or seven days the larvae complete their feeding,

having shed their skin twice, and pass into the pupal stage. The pupa is a small, oval, darkish-brown body which might be mistaken for some kind of seed. In warm weather the flies develop in a few days inside the pupal skin, and emerge, to lay another batch of a hundred or more eggs.

Adult flies possess a small pump by which they suck up food. If they alight on bread, sugar or other solid food they emit saliva, which partially digests the food, turning it into liquid.

The danger to human beings lies in the fact that flies carry disease germs on their feet. These are provided with pads, covered with bristles, and exuding a sort of glue by means of which they can cling to almost any surface. As the flies frequent all sorts of places when decay is taking place, they may pick up the germs of diarrhoea types of disease, and convey them to food direct or to the rims of milk bottles and jugs, dishes and so on, from which contamination can spread.

The best preventive measure is to keep flies down by scrupulous cleanliness, thus allowing no breeding places; by keeping all food carefully covered and inaccessible; and by securing the lids of all dust bins.

The common house fly may be recognised by its dark ash-coloured body with black stripes down the thorax and one on the abdomen. It does not bite or sting, but several other fairly common forms do.

2. *APHIS* or *GREEN FLY*. There are many aphides, some green, some black, some woolly, all causing what are known as blights, that is, they multiply rapidly in warm weather, especially where rapid growth of young shoots has rendered them vulnerable, and in a few

days cover huge surfaces causing serious injury. They pierce the skin of leaves and stems, near the tips of young shoots particularly, and suck the sap. Many kinds secrete a sticky, unpleasant juice (e.g., on sycamore and lime) which possibly interferes with the function of leaves by clogging the pores. The proboscis is a short, sharp, piercing tube, capable of suction.

Eggs hatching in the spring from a batch laid in the autumn develop in a few hours into wingless adults, feeding actively. From the end of the body they produce on an average two similar offspring a day and these in their turn go on multiplying at the same rate under favourable conditions.

This type of reproduction takes place without any male forms being needed, that is, these females produce unfertilised eggs which hatch. From time to time, especially if food is getting scarce, a few winged females appear, which migrate to new pastures and so extend the "blight." They do not reproduce their kind so rapidly as the wingless forms, and have a more gradual growth, often protecting themselves by a silken web or by curling up leaves.

In the autumn, wingless females and winged males appear, which unite to produce fertilised eggs, and it is these eggs, laid amongst the bud scales, that survive the winter.

Thus, the rule is, rapid production of summer broods from unfertilised eggs under favourable conditions, but slower production of smaller numbers of fertilised eggs, to make sure of survival under winter conditions.

3. *DEATH-WATCH BEETLE*. The death-watch beetle and the furniture beetle are closely related. In

each case, it is the burrowing of the larva that causes serious injury to wood. They have a marvellous power of digesting wood and obtaining nourishment from it. The wormlike, white larvae have hard biting jaws, and as they tunnel they push behind them the sawdust or "frass" which falls out as powder. The tunnels destroy the wood, often rendering structural beams and floors dangerous by serious weakening. After two or three years the larvae pupate. The adult beetles are small dull brown creatures about $\frac{1}{8}$ in. long. They come out of the wood, and after laying eggs in surface crevices, from which the young larvae start making new burrows, die.

4. *PEAWEEVIL or RED-FOOTED BEETLE.*

Although popularly called a weevil, this insect is technically a beetle. It is dark-coloured with red *feet* (first two pairs), while the nearly related bean beetle has red *legs*. It also has dark spots on the pale exposed tip of the abdomen. It eats away the inside of the seeds, destroying the germ. The eggs are laid in the flower, and the young larva at once enters the pod, and then a developing seed. Here it feeds, until it is ready to pupate, when it bites a hole almost to the surface. Pupation takes place in the seed, and the mature beetle bites its way out. Apparently the infection comes from foreign-grown seed and the beetles do not seem able to persist in England to establish themselves as a regular pest.

5. *GREEN OAK MOTH or GREEN TORTRIX.*

This is one of the common moths whose caterpillars suspend themselves by threads from oak leaves. The moth,

which is green and grey, with fringed wings, emerges in May and lays eggs on oak leaves. The caterpillars, green with black raised spots, do much damage, often stripping the trees. They pupate in rolled-up leaves.

6. *APPLE SAWFLY*. The sawflies belong to the same order as bees, wasps and ichneumon flies. By means of a sawlike apparatus connected with the egg-laying tube, the females cut holes into which they drop their eggs. The larva which hatches looks like a caterpillar and behaves like one, but it has six to eight pairs of "prolegs" on the abdomen, whereas caterpillars have never more than five pairs; i.e., the first two segments of the abdomen do not have them.

The eggs of the apple sawfly are laid in the blossom, the larva hatches and bores into the young fruit and eventually brings it down. The grubs, when fully fed, eat their way out and pupate in the soil round the tree. Hence the best treatment is to bury the top 2 or 3 in. of soil deeply, or burn it on a bonfire, to prevent the flies from emerging. Trees may be sprayed in April with paraffin emulsion (1 wineglassful to 3 of soft soap in 3 gallons of water).

7. *DADDY-LONG-LEGS* or *CRANE FLY*. A notable point in this common insect is the long projection (halter) behind each wing, which represents the lost second pair. The male has a thick, pointed abdomen, (slender in the female), ending in a pair of projections whose purpose is to hold each egg as it emerges and push it into the soil. From two hundred to three hundred eggs are laid separately. The legless larvae or leatherjackets have strong biting jaws, with

which they feed on the roots of grasses, including corn, doing serious damage. The remedy where large numbers exist is to cover the ground with rubber sheeting and flood under this with water. Birds, e.g., rooks, destroy a great many. They are dull, earthy colour, and reach a length of about 1 in.

8. *WOOD WASP*. This causes injury to fir trees in the same way as the furniture and death-watch beetles in other wood, by boring tunnels, in its larval stage, and feeding on the wood. These tunnels are, however, much wider as this is a bigger creature. It is interesting to notice that insects of very different types may have similar habits. The wood wasp is more like a sawfly than an ordinary wasp, having no "waist," but its colouring is like a wasp. A long boring instrument projects from the abdomen, giving it the name of horntail.

9. *POPLAR WEEVIL*. This is an instance of the name "weevil" given popularly to beetles which are not true weevils. It is one of many "longhorn" beetles whose soft, legless or almost legless larvae burrow in trees, destroying the wood. The word "weevil" seems to be derived from the same root as "weave" and is applied to many beetles which make a network of tunnels.

10. *COCKCHAFER*. Both larva and adult of this beetle are highly injurious, the larvae feeding in the soil on roots, the adults biting the leaves of trees and often almost stripping the trees in years favourable to them. Sometimes called May bug, June bug, or dor

beetle. They fly with a heavy flight, and swarms of them are sometimes at first mistaken for bumble-bees. At close quarters they are seen to be nut-brown beetles with curious comblike antennae. The larva is white, soft, and sluggish, with a brown hard head and strong jaws. It feeds in the soil for two years, pupates for a short time, but remains in the soil, as a beetle, through the winter, emerging in May or June, when it is practically three years old. The eggs are laid in holes 2 or 3 in. deep in the soil, in small clusters, and hatch in five to six weeks. The best way to get rid of cockchafers is by keeping a sharp look out for the larvae or brown pupae when digging. The larvae are like caterpillars, but have no abdominal legs. They always lie in a curled position.

II. *CLICK BEETLE*. The larva is the well-known "wireworm," a slender, active, shining, yellowish creature which wriggles away as one digs. The eggs, laid under the soil in May to July, hatch into tiny whitish larvae, which change their skins many times becoming deeper in colour each time. Powerful jaws can attack and kill other insects, though their usual food is the roots of all kinds of plants and underground stems, such as potatoes, which may be riddled by them. They feed for about five years before pupating in a burrow in the soil, and emerging as slender brown or blackish beetles.

Rough grassland is very often the original source of infection. To remedy this, the turf should be deeply turned in, and the soil well rolled; a crop of potatoes, closely sown mustard or rape, will usually help to get rid of them. In small areas they may be trapped by

burying potatoes or carrots through which a stake has been pushed, which protrudes above the soil. These may be lifted from time to time, when they will be found to have attracted many wireworms. A dressing of crude naphthalene (3 oz. to sq. yd.) is often effective. Pupation takes place in late summer; a month or so later the beetle emerges, usually to remain in the soil till the spring.

12. "*CUTWORM*" or *TURNIP MOTH CATERPILLAR*. Dingy looking, fat caterpillar which cuts through seedling plants just above the soil, or feeds on them below the ground. Often turned up when digging. It feeds at night, hiding by day under dead leaves, soil or grass. The yellow underwing moth has a caterpillar of similar appearance and habits, and so has the heart and dart moth. Caterpillars are greyish or brownish, with black dots down the sides. Moths appear in June and again in August and September. The caterpillars may feed either rapidly, pupating in July to produce moths in August, or more slowly, not pupating until February to April, but passing the winter as caterpillars in the soil. The moth has greyish-brown front wings with dark markings and white hindwings.

13. *BOTFLY*. A two-winged fly which lays its eggs on the hairs of the horse, which, by licking them, causes them to hatch. The small maggots are swallowed and feed on the lining of the stomach. When fully fed they are passed out with the dung, bury themselves in the earth, and pupate. The flies are hairy and rather bee-like, but with a short ovipositor projecting from the

abdomen. The larva at first is club-shaped, with rings of small spines; hooks surrounding the mouth enable it to cling to the stomach lining. Later, the hinder end becomes greatly swollen into a barrel shape with food—this is the “bot.”

14. *GADFLY* or *WARBLE*. The fly lays eggs on the hairs of the legs of cattle, and the maggots bore through the skin, making their way through the tissues till they reach the wall of the gullet, where they remain in a resting condition for some months. They then take up their wanderings again till they are just under the skin of the back, through which they bore holes and escape, causing sores or “warbles” and ruining the hide. They bury themselves in the soil to pupate, then emerge as flies.

15. *GALL WASPS*. These numerous, minute black insects pierce the tissues of plants by means of a sharp ovipositor, and insert their eggs. The larvae hatch and set up irritation which results in the formation of a blister or gall, inside which the larva lives. The marble gall and spangle gall on oak, and “Robin’s pincushion” on rose trees, are examples. Each gall has its own characteristics, but there is usually a hollow cavity in which the larva lives, and a nutritive layer surrounding it, with a hard protective layer outside this, and then probably softer outer layers. When the soft, white, legless larva has grown to its full size it pupates inside the gall, and later the perfect insect bites its way out. Marble galls from which the wasp has escaped, are common late in the year. Eggs laid in September or October, at the ends of branches or in the axils of

leaves, develop in the following year. Young galls are greenish, then yellow, and soft; they gradually darken and harden. They do not cause serious injury in most cases, unless they are present in great numbers; they are, of course, using some of the food supply of the plant.

16. *CLOTHES MOTH*. There are two or three species of clothes moth, all very small, belonging to the genus *Tinea*. Eggs are laid in fur, feathers or woollen materials, and the larvae feed on their substance—another instance of marvellous digestion. The clothes moth or tapestry moth spins a web in which to conceal itself as it feeds; the woollen moth, perhaps commoner, makes a case of minute particles of the material, which is an even better concealment. They pupate inside their cases, usually in some hidden corner, and remain through the winter, emerging as moths from February onwards and giving rise to several broods in the season. They dislike cedar wood, so that a cedar lining to boxes and wardrobes is an efficient protection. Cedar wood oil, naphthalene, camphor, all help as preventives but the best thing is to shake and air furs, clothes and blankets frequently.

17. *HESSIAN FLY*. A minute black fly whose larvae feed on the stems of wheat near the ground, lying just above a node, protected by the leaf sheath. The innermost leaf turns yellow, the first sign of the attack. The stem is weakened and easily "elbowed" when the ear becomes heavy. Results visible in July. Pupation occurs in the stubble or amongst hay carried away, and flies may emerge in the autumn, in which case they die before winter-sown wheat is above ground.

or they remain as pupae through winter and emerge in early summer, in time for spring-sown wheat. For this reason they are a greater pest in America, whence they were introduced to England.

18. *TURNIP "FLEA."* These are small beetles, not more than $\frac{1}{8}$ in. long, which eat the young leaves of members of the cabbage and turnip family (*Cruciferae*). Some are metallic blue and black, others have a yellow stripe on the black wing case. It is the adult beetle that does the damage. They jump when disturbed. They spend the winter especially in hay stacks near turnip fields, and emerge when the first seedlings are barely out of the seed. At first they feed on any cruciferae; later they usually concentrate on turnips, swedes and cabbages, flying from crop to crop. Eggs are laid on the soil from the end of May to September; young larvae either crawl up and burrow into leaves, or *down* into roots (different species behaving differently) where they live until they are ready to pupate, when they crawl into soil. In three weeks the beetles emerge. The irregular holes all over the seed leaves and first foliage leaves of seedlings betray their presence. The best means of preventing their attacks is to promote quick, healthy growth of the young plants. Heavy watering and spraying with soapy water and a little nicotine are recommended. Charlock seems to encourage them. Clearing away all refuse which affords winter shelter will lessen the danger from this and many other pests, including parasitic fungi.

19. *PEA AND BEAN THRIPS.* Minute, slender, four-winged flies, about $\frac{1}{16}$ in. long. Details can be seen

only with a microscope but the narrow wings are fringed with hairs. The young are like the adult, but wingless. In the pea thrips the young are bright orange with a black tip. Eggs are laid in June in the stamen sheaths or very young pods. They hatch in 8-9 days, and the larvae begin to feed by scraping away the inside of the pod, leaving it thin, pale silvery, and mottled or patchy in appearance. After three or four weeks the young find their way into the soil, where they spend the winter, emerging in the spring. It is best to avoid cropping the same ground with peas after an infection as the flies will emerge again from the soil in the next season. A nicotine and soft soap spray of the young pods, if infection is observed, is effective. (The Ministry of Agriculture leaflet gives $\frac{3}{4}$ fluid oz. nicotine 95-98% to $\frac{1}{2}$ -1 lb. soft soap—according to hardness of water, and 10 gallons water.) N.B.—*Very* important to keep nicotine under proper control as it is a *dangerous poison*.

20. *TURNIP SAWFLY*. Note the same general features as described for apple sawfly—small four-winged fly and many-legged grub, which lives inside the turnips. Eggs laid on leaves by cutting a hole with a pair of "saws," part of the egg-laying apparatus. The larva feeds on the leaves like a caterpillar, nibbling round the edge till all the soft tissue is eaten. Like a caterpillar it curls up when disturbed, but can be distinguished by its many legs.

15. *World distribution of trees*. (*Vol. II., p. 23.*) A record of the types of trees existing mainly under the climatic conditions peculiar to the principal geographical

regions of the world. The information given in the picture may be summarised as follows:—

NORTHERN HEMISPHERE.

Coniferous trees are mainly found in latitudes 45° – 75° with strips in mountainous districts as far south as 10° in the continents of North America, northern Europe and Asia. Conditions for growth are, rain at all seasons of the year, (about 10–20 inches in summer) and a range of temperature of from 32° or less in winter to 64° in summer.

Deciduous trees are found south of the conifers, chiefly in the temperate zone (60° – 30° Lat.), but reaching nearly to the equator in south China. Very few are found in Africa. They also need rainfall at all seasons, preferably up to 40 in. a year, but can exist with only 10–20 in. The temperature may vary from 48° in winter (southern limit) to 64° – 80° in summer.

Evergreen trees are found between latitudes 35° – 45° , in the region of the Mediterranean and between 28° – 38° north of the Gulf of Mexico. In these regions the rainfall is much greater in winter, and may be up to 80 in. Can accustom themselves to considerable variations of temperature.

Tropical trees exist up to about 28° N. Lat., in South America, parts of North America, Africa and southern Asia. They require a rainfall of at least 80 in., and a general temperature of 80° .

SOUTHERN HEMISPHERE.

Coniferous trees are almost negligible in the southern hemisphere.

Deciduous trees occur in the temperate zone, latitudes 22° – 55° . They are found mainly in eastern Australia and the southern Andes. The rainfall in these districts varies from 40 to 80 in., and the range of temperature between 48° and 80° .

Evergreen trees are found between latitudes 30° and 40° , in southern Australia, Africa and America. The greatest rainfall is again in winter, varying from 5 to 40 in.

Supplementing these facts the following details are noteworthy:—(a) Coniferous trees, the most northerly, extend into the coldest regions, just into the arctic circle. In the corresponding region of the antarctic there is mostly water or land permanently snow-covered, and hence tree forms are negligible. The conifers represented in the arctic circle are dwarf pines. Where deciduous trees are found—willow, birch—they are also dwarf forms. Such trees can survive the cutting winds of the winter only if they are beneath the snow; hence they grow only to a height that the snow covers; buds above this are nipped by the wind. The trees are therefore flat, as if sheared off.

(b) On the whole, conifers grow in regions of less rainfall than the deciduous trees. As their narrow, tough leaves give off less water, their roots take in less.

(c) The deciduous trees are typical of the temperate region. They share the land with the grasses—prairies, steppes, meadowland—and it is chiefly a difference in water supply which determines whether trees will succeed in the struggle for existence.

This has had an effect on the life of man. If trees grow, man will take to hunting and woodcutting. He will export skins and wood, whether the forests are

coniferous or deciduous. If grasses are established, the land becomes the haunt of wild horses and cattle. Man the hunter gives place to man the cattle and horse breeder, and later, the grower of corn. Thus the destiny of the races of man has been linked up with the destiny of trees or grassland.

Cattle, by grazing, tend to increase the grasslands, since they destroy the trees by tearing off bark and branches, and eat the young seedlings.

In another way, trees in masses influence the life of man, for the water drawn up through their roots passes at last out of their leaves, the great mass of vapour condenses, and in due time descends again as rain. It is, therefore, of great importance not to cut down trees recklessly without giving thought to the effect this may have on the climate. The barrenness of the rocky island of St. Helena is attributed to the cutting down of its trees.

(d) The tremendous rainfall associated with the tropical forests works in a circle, for the rain pours down and the massive trees soak it up rapidly, passing it on again. The cooler night causes condensation, clouds form and the rain falls again. Hence heavy storms at frequent intervals are characteristic of tropical forests.

16. Vertical Distribution of Trees on a Mountain.
(*Vol. II., p. 25.*) A study of the distribution of trees throughout the world is incomplete without a consideration of their vertical distribution. Just as tropical trees occur in the hottest and wettest lands, deciduous trees in temperate climates and conifers in northern areas, so in typical mountainous regions, warm damp valleys

pass upwards to cold, windswept and well-drained summits. Hence, broad-leaved trees with tender leaves give way to small-leaved conifers, then beyond the trees to grass and, finally, to bare rock covered only with dry lichens as in the arctic circle. It is possible in a tropical region to climb a mountain, such as Kilimanjaro in British East Africa, not 4° N. of the equator, journeying from tropical forest right through all these zones of vegetation to a final region of perpetual snow.

17. Trees—1. (*Vol. VIII., p. 480.*)

OAK.—Summer. Large, almost spherical (flattened above and below) crown with dense foliage reveals only short length of rugged, furrowed bole (trunk). Light yellowy green at first, with slender tassels of flowers before leaves quite fully expanded. Leaves in bunches give bosky appearance. Late in opening.

Winter. Branches twisted in short curves in various directions together with ridges bearing lateral (side) buds and clustered terminal groups of buds give gnarled effect; each bud bluntly oval, with many small overlapping scales. Branches neatly furrowed, old boles deeply and irregularly cut, with thick ridges of bark. Large branches come off close together from short bole.

ASH.—Summer. Foliage not so dense as oak, and with lighter effect owing to division of leaves into leaflets (pinnate) letting through light, and greater spacing of leaves of twigs. Branching does not begin so low as in oak. Leaves turn pale yellow.

Winter. Slender, with smooth lines. Extremities of branches often curve down, then twigs curve up again.

Furrowing very regular, mesh rather small and furrows not deep. Buds black, sooty. Pyramidal terminal buds much larger than lateral buds, which are arranged in pairs, each pair at right angles to the one above and below. The twig is flattened at the nodes (where buds come off) in the plane in which the buds project.

BLACK POPLAR.—*Summer.* Common in town streets, and hardy. Black bole and lightish green, almost triangular, leaves, turning deep lemon yellow in autumn. Foliage not dense. The trees seen mostly are fairly young, with longish bole and deep rounded crown, perhaps rather pyramidal. Old trees (c.f., willows—relatives) decay and often lose branches or even upper part of crown, owing to absence of hard heart wood. Compensated for by bushy lower growth from dormant buds. Opening buds very noticeable—long, with pointed scales. Large pink catkins. Bark deeply furrowed.

Winter. Black stems and olive-brown, smooth, pointed buds. Rather open growth and long, straight branches and twigs.

SYCAMORE.—*Summer.* Dense, large-leaved foliage, rounded deep crown, longer bole (before branching begins) than oak, and as branches do not curve downwards very much, foliage is held higher. Opening buds deep pink with long, smooth inner scales. Inflorescences are large green, pendant tassels. Leaves palmate, i.e., broad and cut into deep points, like fingers.

Winter. Stiff, clipped appearance seen in silhouette, due partly to large terminal buds and especially to loss of many terminal buds which have borne fruits. This

causes two lateral buds immediately below to grow, and it is this regular arrangement that has such a stiff appearance, added to the fact that it causes repeated regular forking of the branches, year after year. The branches are smooth elephant grey, broken here and there into irregular scale patches, the buds are green; the trunk and lowest branches dark grey, often with a green film (small water plants) and rough, oblong or squarish scales.

18. Trees—2. (*Vol. VIII.*, p. 481.)

COMMON ELM.—*Summer.* The elongated crown of a mature tree consists of a number of ragged masses of foliage, broken by spaces due to branches having fallen away. (Brittle—no heart wood—one reason why elms constitute a danger in frequented areas). Branching begins low down, and the branches are spaced, not, as in most trees, all the main branches arising close together. Thus the trunk can be traced to a high level. Leaves small, rough and toothed at the edge. Foliage light in effect. Bark irregularly and deeply furrowed. Small brownish clusters of flowers very early, before leaves; fruits (pale green discs) well-developed before the leaves open, but few reach maturity and seedlings rare.

Winter. Plan of branching described above can be more readily seen, together with thin, supple twigs, branching so closely that they form a misty edge to the tree against the sky. Buds very small, spirally arranged. Whole effect very light.

WYCH ELM.—*Summer.* The crown widely spreading and reaching down close to the ground. Leaves much

bigger than in common elm, with a long point, otherwise oval, except that in many leaves one lobe joins the stalk some distance lower down than the other. Flower clusters bright crimson, in February or early March.

Winter. Compared with common elm, it can be seen that the different shape of the crown is due, first to branching taking place very low down, and secondly to the main trunk dividing at once into 3-5 (or more) main branches, which are long and fairly straight, together making a broad fan-shape from any point of view. The twigs are very like those of the common elm. Flower buds in both are large and round, and many tiny overlapping scales, but foliage buds are small and pointed, and pressed close to the stem.

LIME.—Summer. The leaves are a light, clear green, growing darker as the season advances. Each heart-shaped leaf would fit into a square, with its long pointed apex projecting. They are larger than those of the common elm or beech, and finely toothed. The general effect of foliage is light. Old trees have an elongated crown, usually not spreading very widely, and tufts of twigs round the base. They are often grown as avenues, or in groups, a habit that checks full individual development. Where a single old tree can be seen, it may be wide-spreading and stately. Cream-coloured nectar-giving flowers are suspended below long stalked leaves, on strap-shaped bract which becomes wing of fruit.

Winter. The open growth and graceful, slender branches are outstanding characters. The twigs are well spaced; the buds project from the twigs at rather

a wide angle (about 60° – 90°). Each bud is oval, with a short point, and slightly flattened on the stem side. They are usually red, but may be green next the twig, while those on twigs near the base are frequently green. At first smooth, the bark grows gradually furrowed, having very long oblong ridges divided by almost parallel grooves and by short transverse cracks.

ALDER.—*Summer*. Rather irregular, shaggy growth. Tree tall, supple, and not very wide-spreading, branches occurring at different levels. Younger trees often pyramidal. Leaves broad oval, with slightly indented apex and prominent veins. Dark, dull green. Amongst the foliage will be seen the green cones which are the developing fruits of the current year, together with brown and black ones of previous years, which have shed their seeds. The cones grow in clusters, up to about a dozen together, each cone being about half-an-inch long. Before the leaves come out, bronze and yellow catkins, and tiny crimson cones which are the pistillate (seed-bearing) inflorescences, can be found.

Winter. Bluntly oval buds curve against the crowded twigs, and stiff young catkins can be found. The twigs are knotted and ridged at close intervals, and each bud is borne on a dwarf twig.

19. Trees. 3. (*Vol. VIII.*, p. 482.)

HORNBEAM.—*Summer*. In shape and size somewhat like beech, a full grown hornbeam can be readily distinguished by the bark and leaves. The bark is furrowed (whereas beech is smooth) and the furrows are long, the ridges between sending sharp projections into them, which make a decorative pattern. It is not

cut up into spindle-shaped masses as in ash, oak and elm. There is often a tendency for the furrows to sweep spirally round the tree. In younger trees and branches, the position of the furrows is marked out before they actually appear, by light, smooth bands contrasting with the rougher areas which will be the ridges. The leaves are about the size of beech, but are toothed and change to a paler yellow in autumn. Hornbeam is frequently grown as a hedge plant, when the leaves, occasionally elongated, become a distinguishing feature.

Winter. The bark and branching may now be more clearly distinguished; all the main branches arise together, as in beech and spread widely, some bending at right-angles or making still greater angles with the main axis. The buds are narrow and long, but neither so long nor so smooth as beech, for the scales project slightly at the tips. If the fruits can be found still on the tree or near it, they are helpful for recognition. They look like tripartite leaves, strongly veined, curved round slightly at the base to hold a flattened nut not unlike a sunflower "seed." The central point of this winged bract (which helps in wind dispersal) is longer than the side ones.

SWEET CHESTNUT.—*Summer.* A wide-spreading tree, having many thick branches rising close together and spreading to support an almost circular dome of leaves, flattened below. Dark coloured, strongly furrowed bark in which the furrows are deep and long, often tending to have a spiral direction. Long, pointed leaves of rich, glossy green, turning a deep, tawny orange (like oak) in the autumn. The margin is very

distinctly toothed. The fruits are enclosed in a green cupule, thickly beset with stiff, long spines. The fruit itself is a glossy brown nut; for a long time the branched stigmas remain attached to the ripened ovary.

Winter. The long regular furrows of the bark, and the long buds, pointed at the apex, are characteristic. Also the leaves and fruits on the ground help in identifying the tree.

SCOTS PINE.—*Summer and Winter.* Evergreen. The seasons make little difference to the general appearance of the Scots pine, but at close quarters in the early summer the new pale greyish-green shoots, enclosed at the base in pinkish-yellow chaffy scales, shew that growth is taking place. Tightly clustered knobs of yellow stamens are the staminate flowers, while pink cones, with scales curving outwards at the tips, are clusters of pistillate flowers, which will develop later into green, then brown cones, taking three years to ripen.

The tree has a tall, scaly trunk, giving rise to short branches at intervals up the long trunk. Later (as in the common elm) some of these branches are shed and leave jagged ends projecting. The irregular masses of dark evergreen foliage are thus separated by gaps. The leaves are "needles," borne in pairs, arranged in close spirals like bottle brushes in shape.

SPRUCE FIR. *Evergreen.* To distinguish a fir from a pine, compare the leaves. In a pine, they are long, and arranged in pairs, having a bushy effect, whereas in a fir, they are single, shorter, and have not the closely whorled appearance of the pine. The *Christmas Tree*

is a spruce fir. The regular, pyramidal form is characteristic of the trees to a great age, though there is a great tendency in forests to lose all the lower branches, keeping only a number of thin, dry twigs, while only the tops remain in full foliage.

CEDAR OF LEBANON. Evergreen. The leaves are arranged singly, as in firs, but are very short. But it is the branching which is so typical and easy to recognise, for the smaller branches grow horizontally from the larger ones, so making well-defined shelves of dark foliage, with large spaces between the layers. The cones are oval, rounded at both ends—not tapering as in pine and fir—and smooth, with closely-fitting scales flush with the surface.

LARCH. Though a cone-bearing tree, related to the three preceding ones, this is not an evergreen. The light green leaves turn yellow, then rusty brown in autumn and finally drop off. They are arranged in tufts, each tuft borne on a dwarf branch, and when the leaves fall, the short, ridged projection on which they were borne remains, giving the twigs and branches a knobby appearance. Small light brown, ripe cones can usually be found. These have free, thin edges overlapping one another. The ruby red, flowering cones are a lovely sight in the spring, coming at the same time as the sprouting leaves.

20. Some Winter Twigs Showing Buds. (*Vol. II., p. 20.*) In order to keep in touch with nature during the winter months, it is a good plan to be able to recognise some of the common trees by their buds.

Illustrated are twigs of eight common trees showing very distinctly differences in position, formation and effect upon growth and appearance of parent tree.

A bud is composed of a portion of a stem—the growing point—together with a number of small outgrowths—the developing leaves. The winter buds of trees and shrubs become the summer buds by losing their protective scales, for however many leaves unfold, there is still a bud, with a growing point, at the tip of the stem.

As the summer advances, growth at the tip becomes slower, the leaves develop more slowly and by July have usually stopped altogether. The summer bud then becomes the protected winter bud, for the leaves on the outside of it are incomplete, being either leaf bases; e.g., horse-chestnut, sycamore, or outgrowths of leaf bases (stipules); e.g., beech, lime, folded round it.

While growth is active, small buds are also formed immediately above the point where each leaf joins the stem—in the axil of the leaf. These are therefore called axillary, or lateral, buds. Leaf scars are readily noticed with buds above them.

After the leaves have finished growing, both the axillary and apical, or terminal buds swell to their full size, and then the outer scales harden to resist the cold winds, frost and rain of the winter.

21. Diagrams Showing Arrangement of Veins in a Dicotyledonous Stem—Cross Section. (*Vol. II., p. 30.*) The veins are extremely important in a plant just as they are important in a human body, for they conduct the water taken in by the roots, through the entire plant. The sections of a stem in the diagram illustrate

how the conductive cylinder is formed by the enlargement of the primary veins as the plant grows older. In young plants, isolated veins are sufficient to carry the supply of water up from the roots, but as plants grow in thickness more tubes are needed for this purpose. The need is met by new tissue forming between the original strands and, later, there is still greater growth both towards the centre and towards the outer surface, until eventually a firm, compact conductive cylinder is formed. This serves the double purpose of providing for conduction and for mechanical support, for the greater part of the tubes and fibres which compose it have their walls strongly thickened with wood. (The outer part of the conductive cylinder, called the bast, is concerned with carrying sap *down* the stem and distributing dissolved food material made by the leaves. Separating the two tissues, wood and bast, is an actively growing layer from which both are formed.)

22. Cross Section of Branch of Oak in Third Season. (*Vol. II., p. 31.*) The composition of a branch. If branches of some trees can be obtained, it would be useful for practical purposes to saw them across, sand-paper the cut surfaces and then lightly polish with linseed oil. The characteristics of the stem would then be distinguishable.

On the outside is a layer of bark, quite thin in a young branch, growing thicker each year.

Just underneath this there may still be a narrow band representing the soft ground tissue or cortex which in a seedling, such as broad bean, makes up the greater part of the stem. A thin, whitish line is the outer part of the conductive cylinder, the bast. This

tends to get crushed against the bark by the pressure of the vigorously growing wood, so that only its innermost part is in use.

The greater part of the cylinder consists of wood. The older wood, pushed towards the centre, is no longer of use in conducting water, but becomes very hard and often contains substances, such as tannin in oak, which preserve it. This is called heart wood and is usually darker in colour than the active or sap wood.

Fine lines radiate through the wood from the centre to the bark. These *medullary rays* make it possible for liquids to pass horizontally, and thus food can reach all parts and keep the plant alive.

The light and dark alternating circles throughout the whole of the wood are due to the fact that growth is quicker, and therefore the wood is more open, and lighter looking, in the spring and early summer than in the late summer. The closer growth causes the appearance of dark lines terminating each year's growth; hence, the term, annual rings.

23. Section of Part of a Leaf. (*Vol. II., p. 32.*) The pores or stomata are of great importance in the life processes of a plant. Noteworthy points are:—

(a) The guard cells on either side of each stoma. It is the inflation and deflation of these which cause the stomata to be either open or closed.

(b) Transpiration (the giving off of surplus water vapour by the leaves) is regulated by the stomata. When the air is dry, transpiration is greater than when moist, the guard cells closing in damp weather and opening in dry.

(c) Stomata occur mainly on the under side of the leaf so that excessive transpiration caused by exposure to the sun is avoided.

(d) Chlorophyll grains shown in upper diagram are responsible for the green colouring matter of the leaves.

24. Pollination of Flowers. (*Vol. II., p. 121.*) Some of the common wild flowers showing their different colours and shapes, and how these influence pollination.

1. *POPPY*. Cup-shaped, offers pollen but no nectar to all insects, relying on chance of large numbers transferring some pollen to same kind of flower.

2. *CRAB APPLE*. Cup open to all. Attracts by colour aided by clustered arrangement. Nectar—in disc round base of style—and pollen.

3. *MEADOW VETCHLING*. Crowded inflorescence conspicuous. Free petals, held by united sepals, form a tube, broadening into standard, and wings at side, enclosing boat-shaped keel formed by union of two front petals. Stamens form a tube, making nectar at base difficult to reach. Pollen falls into keel. Insect drags down wings and keel, brushlike style projects and sweeps out pollen which dusts chest of insect. A bee flower, as are most irregular or bilaterally symmetrical flowers.

4. *COW PARSLEY*. Minute white flowers crowded into a flat inflorescence (umbel). Outermost petals larger, increasing attractive effect. Nectar open to all, on flat disc at base of styles. Masses of flowers bloom in May with striking effect. Stamens ripen before

pistils, ensuring cross-pollination. Visited chiefly by flies.

5. *TOADFLAX*. Like meadow vetchling, but more advanced in having petals united, making nectar at base of tube more difficult of access. Closed at throat by a pouch in the front petal, which is also produced into a spur. Inflorescence a conspicuous raceme, flowers sulphur-yellow with orange spots attracting attention. A bee flower.

6. *FIGWORT*. Of same family as toad-flax (*Scrophulariaceae*) but unusual in having upper flowers opening before lower. Pollinated by wasps, said to begin with the upper flowers and travel down. Since the pistils ripen before the stamens, this would ensure that pollen, from lower flowers, was carried to other plants. Dull purplish and crimson.

7. *FORGET-ME-NOT*. Conspicuous yellow rings on blue ground act as honey guides, the classical example first studied by Sprengel, discoverer of cross-pollination. A little nectar is secreted on disc at base of short tube, but if not visited by bees pollinates itself by growth of corolla bringing stamens into contact with pistil.

8. *MEADOW CRANESBILL*. Large regular blue flowers with two rings of five stamens, nectaries alternating with outer ring. Stamens open first, bending outwards after shedding pollen.

9. *ARCHANGEL*. Rings of yellow flowers conspicuous, as is shape of flowers. Tube of united petals

spreads to form a hood and lip. Hood protects stamens and forked stigma till ripe, when they grow beyond it, stigma downwards. Insect alights on lip and is guided by orange lines on it. Seeks nectar at base of tube, brushing head and back against stamens and stigma. A bee flower.

10. *RED CAMPION*. Regular (cyclic or radially symmetrical) flowers. Long tube of free petals widens into salver-shape held by calyx of united sepals. Small projections form a corona which partially blocks throat, as in forget-me-not. Nectaries at base of tube. A butterfly flower, but white campions pollinated by moths. Stamens ripen first.

11. *COWSLIP*. Cyclic flowers with long tube of united petals. Orange spots on yellow cup probably honey guides. Umbel conspicuous. Flowers of two types: *pin-eyed* with long style, *thrum-eyed* with anthers in this position and short style. Throat widened in thrum-eyed type to accommodate the cluster of anthers. Cross-pollination ensured since the shorter organs touch the tongue and the longer ones the head or base of the tongue of the visitor. Long-tongued insects only can reach the nectar.

12. *HONEYSUCKLE*. Sweet scent at night and pale colour attract hawk moths, the only insects with sufficiently long tongues to reach the nectar. Irregular, conspicuous flower; umbel also easily visible.

13. *LIME*. Strong sweet scent indicates presence of nectar, which is copious. Open flowers allow any

insects to take it, bees especially. Not conspicuous, sheltered by leaves.

14. *RYE GRASS*. Like all grasses, wind-pollinated. Stamens swing on long, slender stalks, feathery stigmas catch and hold dry, light pollen. Inflorescence held clear of surrounding foliage so that wind reaches it.

15. *ALDER CATKINS*. Wind pollinated. Compare with grass. Dry, light pollen scattered in clouds. Petals minute, reduced, not conspicuous; no scent. Flowers before leaves, exposed to wind. Stigmas project from conelike pistillate inflorescences.

16. *RIBWORT PLANTAIN*. Wind-pollinated. Open situations like grasses; flowers held above leaves. Inflorescence a spike, pistillate flowers opening first, circlet of anthers held well away by long stalks. Corolla reduced, but some plantains are still pollinated by insects and others in a transitional state. Their nearest relations having insect pollination are the Scrophulariaceae.

25. Poisonous Plants. (*Vol. VIII., p. 483.*)

1. *YEW*. Young shoots and seeds poisonous, but not the crimson aril, an outgrowth of the seed which surrounds it and forms a waxen cup.

2. *WILD ARUM*. Lords and ladies, or Cuckoo-pint. Whole plant poisonous.

3. *CORN COCKLE*. Seeds if abundantly mixed with grain, poison flour.

4. *ACONITE* or *MONKSHOOD*. All parts. Sometimes the root has been mistaken for Horse-radish.

The leaves are, of course, quite different, being deeply divided.

5. *MEADOW BUTTERCUP* (*Ranunculus acris*) frequently poisons cattle. All buttercups poisonous and juices may irritate skin.

6. *MARSH MARIGOLD*. A source of danger sometimes to children since, like related buttercups, all parts are poisonous.

7. *BOX*. The leaves.

8. *HEMLOCK*. All parts poisonous. The dark purplish-brown blotches are distinctive.

9. *WATER HEMLOCK*. A most dangerous plant. This is well-known, as its popular name of Cowbane shows. It grows 2—4 feet high, with large pinnate leaves, and a furrowed stem. Found in peaty pools.

10. *LABURNUM*. The seeds poisonous. Children should be warned, as they sometimes think they are a kind of pea or bean.

11. *BITTERSWEET*. Poisonous red berries.

12. *BELLA DONNA* (Deadly Nightshade). The berries very poisonous, containing atropin; all parts somewhat poisonous.

13. *BLACK NIGHTSHADE*. Poisonous black berries.

14 *FOXGLOVE*. Poisonous; but used as a drug.

15. *WHITE BRYONY*. Large palmate leaves; bunches of flowers and red berries. Yields useful drugs.

16. *CHERRY LAUREL*. The leaves, containing prussic acid, are very poisonous.

26. Common Fungi. (*Vol. IV., p. 157*).

1. *CORAL SPOT*. The spore-bearing body or fructification of a fungus which penetrates twigs, branches and fences in damp situations, by means of white threadlike suckers which are able to obtain food from the wood. Coral spot is described by its name. It frequently attacks pea-sticks and faggots stored for the winter, as well as dead branches lying on the floor of woods. It bears spores in pits all over the surface of the spots, which are raised.

2. *CANDLESNUFF*. Usually found on tree stumps in damp, mossy places and floors of woods. It bears two kinds of spore; the white powder covering the tips is made up of hundreds of minute masses of protoplasm enclosed in hard walls, while the black lower part is covered by little pits, containing the other type of spore.

3. *JEW'S EAR*. A fructification which is like tough red indiarubber in texture and colour, with curious cavities and ridges moulded to a semblance of human ears—or more like the ears of apes. A yellowish-pink to dull brown. In the young stage these are rounded lumps; the compression and hollows appear later. Some 2-3 in. when fully grown. Found only on elder.

4. *CUP MOSS*. Many distinct kinds, but none like moss, though often hidden amongst mosses. White or light-coloured, rough and warty outside; brown, orange and scarlet inside. About $\frac{1}{2}$ in. to 5 or 6 in. in diameter. They are the spore-bearing bodies of fungi.

5. *STINKHORN*. A creamy, thick stalk arises from a sheathing collar at the base, and bears a small, dark brown, pitted head, which breaks open when ripe to expose a slimy, evil-smelling mass which attracts flies. These feed on the head and bear away the spores and so disperse them, in contrast to the foregoing species, whose spores are dispersed by wind. In some fungi slugs, beetles, and small mammals such as field mice, disperse the spores in feeding on the fructification. Fields.

6. *PUFFBALL*. Found in fields and woods. A short, thick stalk bears a globular saclike head which encloses spores. When these are ripe, a "chimney" appears at the top, and the slightest knock causes the spores to emerge like puffs of smoke. Still used by farmers in some districts as a "styptic" (i.e., to stop bleeding) for wounds of cattle, and formerly used for human beings in the same way (cf. cobwebs). The outside is covered by small, scaly tubercles. White or dingy brown. The vertical section shows the inside before it is ripe, consisting of a network of threads with the cavities filled by ripening spores.

7. *STAGSHORN*. Slightly similar to candlesnuff in general appearance, but larger, much more branched, and of a bright golden yellow. Bears spores all over surface. On wood, in damp places. Grows 2-3 in. high.

8. *FLY AGARIC*. A typical toadstool fairly common in pastures, and *very poisonous*. Consists of a stalk with a swollen, bulbous base, bearing a flat expanded head which is bright scarlet, covered with loose white scales like flecks of suède, the remains of the universal veil or envelope which at first enclosed the whole toadstool. Below the head is a reflexed ring. This is formed from the secondary veil, which extended from the stalk to the edge of the cap in the young stage (cf. mushroom). Some toadstools have remains of one of these veils, some of both, some of neither. The under side of the cap is made up of thin membranous folds, called gills, which are covered by spores. The cap protects the spores, and the folding enables a great many to be produced in a small bulk; there is a very large spore-bearing surface. Summer.

9. *HONEY FUNGUS* or *HONEY-COLOURED TUFT*. Common in woods, or wherever there are trees, and highly destructive, as it attacks living trees and spreads through them until it exhausts and kills them. Unlike the mycelium of most fungi, the honey fungus has one which forms thick, hard black cords driven through the wood. The toadstool is variable in colour, from pale honey-colour to tan or dingy brown, with white gills, later brownish, and usually a well-developed ring, but sometimes the ring is almost absent. It grows in tufts and the white spores thrown down frequently make a characteristic pattern of the gills on the lower members of the group, which are overlapped by the taller ones. The cap has a sprinkling of powdery black or brown scales. One of the commonest of tufted toadstools. Cap 2-3 in. across. Usually seen October-November.

10. *SULPHUR TUFT*. Another very common tufted toadstool growing always on tree stumps. Smaller than the honey fungus, about 2 in. across when full grown. At first, pale sulphur-yellow all over, with olive-green gills and pale yellow or greenish stalks. Then a golden spot appears in the centre of the cap, which turns ochreous, and spreads to the edges. Later, the cap turns dull brown and the gills become almost black as the black spores ripen. A very pretty toadstool. All through autumn.

11. *MATT RUSSULE*. The russules grow in woods, and are firm, compact-looking toadstools with clean-looking white gills and stalks, and pink, red, purple or brown caps. This species is pink. Many of them will be found nibbled, possibly by wood mice, squirrels or rabbits. The gills all run from the stalk to the edge of the cap, i.e., there are no short ones in between, and are fairly thick. The cap is domed at first, then becomes flatter and often slightly hollow round the edge. On ground in woods throughout autumn.

12. *VERDIGRIS TOADSTOOL*. A pretty, medium-sized toadstool of a pale bluish-green—the colour of verdigris. This is due to a slime or mucus, which gradually dries to a pale tan. Common in thickets among grass and brambles, and small specimens often found on lawns. White spores.

13. *MILD MILKY TOADSTOOL*. One of a tribe (*Lactarius*) which all ooze milk when broken, sometimes coloured and in one case peppery in taste. This one has a very mild, slightly nutty flavour, and the milk

is not always copious. It is white. The toadstool is a light cinnamon colour, fading to tan, and is dry-looking. It has a characteristic trim, clean-cut form with a firm stalk and cap and smooth edge. At first round and flat like a coin, later hollowed out into a conical cup. Slightly striate. Common in woods and thickets in autumn, the cinnamon colour catches the eye.

14. *INK CAP*. The example figured is one of the commonest of the ink caps, but there are many different kinds, some large, some small, usually associated with well-manured ground. They are black-spored toadstools, all having in common the breaking down of the mature form in a liquefying (deliquescent) mass, leaving eventually nothing but a little pool of ink-like fluid, which finally dries up. The ink cap figured is found in fields, gardens and lawns, on the ground or decaying tree stumps, but not on dung. The cap is thin, greyish with brown centre, silky and fluted, the gills white at first, later grey, then black, the stalk white, shining and brittle. Slight ring, which soon disappears. It grows in large tufts, and is found in the autumn. Edible when young. Stalk 4-6 in. high and cap 2-3 in. high.

15. *ST. GEORGE'S MUSHROOM*. Often forms fairy rings in pastures in spring. Light tan-coloured, thick, stumpy forms, with shallow conical cap. Smell like new meal. Stem 2-2½ in., cap when full grown 3-5 in. across. Gills crowded and whitish. Edible.

16. *THE BEEFSTEAK FUNGUS*. A shelf-like fungus growing on trees in woods, resembling thick slabs of liver in texture and colour, and when cut open,

having the fibrous appearance and blood-red colour of beefsteak. Often several flaps overlapping. It bears spores in tubes, opening by pores on the under surface, hence belongs to the group of polyporae.

17. *DRYAD'S SADDLE*. Another polypore. The large, fan-shaped, tough-looking cream-coloured masses, striated with light brown and scaly on the upper surface, are well-known parasites on trees, which do considerable damage to the tissues. The fungus should be destroyed as far as possible when seen, as like the honey fungus, it will scatter spores which will infect other trees in the neighbourhood. Any tree which produces the fructification is already seriously infected.

18. *STUMP FLAP*. A pretty, diminutive relative of the beefsteak and dryad's saddle, whose thin, dainty flaps overlapping one another are common on decaying tree stumps and logs, especially near the ground. The lower side is cream and covered with shallow pits, which on close inspection can be seen to consist of minute pores, from which the spores fall. The upper side is richly shaded with bands of green, brown and yellow, parallel with the edge, and fine radial striations. It is also covered with very short, silky hairs which give the surface a velvety appearance. The semi-circular, horizontal flaps are seldom more than 2 in. in diameter.

27. **Small British Mammals.** (*Vol. II., p. 2*). The British wild mammals form a complementary part of the natural society of the country. The carnivorous and insectivorous forms, together with birds, control

mice and insects which tend to rank as pests if their natural enemies are destroyed by farmers and game-keepers. Probably even the rodents—rats, mice, squirrels—play some part in keeping down weeds by devouring quantities of seeds, though there is no doubt they injure crops. Consequently, indiscriminate killing of any wild creature is to be deprecated, both because of the economic results of their wholesale destruction and because of the charm and interest offered to observers of their ways of life. In many cases damage is attributed to birds and beasts of which they are quite guiltless, and real knowledge would do much to remove the evils incurred through ignorant tradition and superstition.

1. *WEASEL*. Male 10 in., female $8\frac{1}{2}$ in., from nose to tip of tail. Slender body, short legs. Rippling, snake-like movement. Small rounded flat head and short snout—like stoat and otter. Short tail, light reddish-brown, short fur. Habitually uses the runs and feeds chiefly on field mice. Contrary to popular opinion, it does very little harm though it may take an occasional partridge or chicken, but amply compensates for the theft by killing hundreds of mice and young rats in hayricks and farm premises.

2. *STOAT*. Male 17 in., female only $13\frac{1}{2}$ in. For a long time thought to be different species owing to difference in size, but always distinguishable by the black tip of the tail, common in both male and female. Long sinuous body and short ears. Rich yellowish-brown, with conspicuous cream under parts. Hunt in family parties, chiefly rabbits, but will take mice, rats

and young birds. Once on the scent never leave it till the quarry is caught. Bite at the back of the neck and feed chiefly on head and shoulders; badgers, hedgehogs, rats, beetles and other scavengers finish it, unless food is scarce, when the stoat will return. On the whole a friend of the farmer in keeping down rabbits and helping to keep the balance of nature.

3. *WATER VOLE or WATER RAT*. $12\frac{1}{2}$ in. The voles are sometimes called short-tailed mice, but differ from mice in having a rounded broad head and blunter nose, longer hair and smaller eyes. The water vole is the largest of them, having a body about 8 in. long, the size of a rat, and a tail about $4\frac{1}{2}$ in. long. Dark greyish-brown, sleek coat. Live in burrows in the banks of streams, where they have two or three litters in a year. Swim and dive well, but not better than true rats. Feed on leaves, reeds, branches of trees dipping into or near water, water weeds, grass.

4. *WOOD MOUSE or LONG-TAILED FIELD MOUSE*. A true mouse, and probably the commonest mouse. Larger than the house mouse; about 7 in. from nose to tip of tail. Legs and tail are longer. Fur light yellowish-brown, not so grey or drab as the house mouse. These are the mice which dig up and eat young peas, nibbling the seed and leaving the shoot behind, with a little hollow where each seedling was growing, and later, running up sticks to eat the peas in the pod. Will often take possession of birds' old nests or the nests of dormice, to which they will take hips and other berries. They make winter stores of nuts and berries in underground homes. (See Hans Andersen's story of

Thumberline for a sympathetic account of their winter ways) Found in banks, hedges and fields, especially cornfields in the autumn; also in ricks, and will enter houses. Preyed upon by owls and weasels especially.

Not to be confused with the yellow-necked mouse, or de Winton's mouse, a distinct and larger variety, also quite common. Both are great climbers, and will make their homes in houses as readily as in their natural surroundings.

5. *DORMOUSE*. Length about 6 in. from tip of nose to tip of tail. Rounded head; bright yellowish-buff hair with white underparts; short ears, long whiskers, big dark eyes; plump body, bushy tail.

Excellent climber. Winter nest well hidden, summer nest about size of a cricket ball in bushes 2-3 ft. from ground, especially in hazel, but also in brambles and honeysuckle. Frequently made of strips of bark lined with a few hazel leaves. Sleeps in day time and roams at night. Hibernates October-April. Lives largely on insects.

6. *SHREW*. About the same size as a house mouse, but has a shorter tail. Though many are killed by cats and other animals, few will eat them. Make run-ways in grass and coarse undergrowth and keep to these routes, shrieking shrilly as they scold or fight with one another. Useful because they catch enormous numbers of slugs, caterpillars and other grubs, as well as spiders, beetles and worms. Thick, close fur like plush, of a dark grey-brown colour; young, light brown. Long, pointed snout and very small, sunken eyes. Unpleasant odour probably disliked by preying animals, though

owls will eat them. Digest food so rapidly that they must be constantly feeding, and it is said that they frequently die of hunger if without food for two or three hours. Exceedingly active and fierce. Many die after a year, possibly the normal span of life.

7. *HARVEST MOUSE*. Length to tip of tail about 5 in. Local and not very common, but its habit of weaving together corn stalks and suspending its nest between them is well known. First described by White of Selborne.

Greyish brown, with reddish hind quarters. Often found in corn, oat and bean stacks; probably carted at harvest. *Food*: largely insects, but eats seeds as well. Usually runs upwards to escape. Needs water.

8. *HEDGEHOG*. Length about 9 in. Known by sharp-pointed head and long spines or bristles. Contracts into a ball when alarmed. Often nests in brushwood or wood piles. Litter of four to six cream-coloured and soft-spined young; easily alarmed, when whole brood will be rapidly removed. *Food*: insects, slugs, carrion; e.g., dead rabbits left by stoats. *Very useful* in gardens.

9. *MOLE*. Length about 6–8 in. Thick, close, short fur, greyish to nearly black. Snout sharply pointed, eyes very small, no external ears. Broad front paws for digging. Lives underground, but known to feed at the surface at times. *Food*: earthworms, slugs, beetles and various insects. Male makes elaborate galleries and domed central sleeping chamber, but excavations made by females are less elaborate. The sexes do not

live together and the animals are solitary. They are thought to need plenty of water, and they certainly require much food, estimated to be more than their own weight daily.

10. *BADGER*. Length 3 ft. Clumsy, heavy body, short legs. Long, rough grey fur, black legs and underparts, head white with two broad black stripes covering small eyes and short ears. Head carried low. A night prowler, living chiefly on insects and grubs, for which it digs. Will kill young rabbits, digging a straight shaft down to their nursery, which it detects by smell. Does very little harm and much good; is quite inoffensive unless attacked, when it will fight and bite hard. Excavates its "sett" or "earth" in rocky woodland, not far from water. Two entrances. Often black and white hairs mixed with bedding thrown out will reveal its presence.

11. *OTTER*. Length about 3 ft. 4 in. from nose to top of tail. Carnivorous and solitary, except during mating season. Mother alone rears young, usually making nest under roots of tree or other sheltered hollow near water. Although the adults are expert swimmers and divers, able to swim for long distances under water and twist and turn to catch fish, the young have to be taught all these activities. Feed largely on fish, but vary diet when obtainable—frogs, snails, eggs and young birds. The head is rounded, with short ears sunk in fur; body long and slim, like a large weasel, with short legs and broad, flat, pointed tail. Five toes. Unfortunately becoming rare through being unmercifully hunted.

12. *HARE*. Length 25 in. Legs and ears longer than in rabbit, colour lighter and more sandy, white underneath. 5 in. longer than rabbit.

Lives in open country, pasture fields or furrows of cultivated fields, especially on gravel or chalk. No nest or lair, but cowers low on ground in slightly hollowed "form." Extremely keen sight, smell and hearing. Colouring affords good protection, while light underside counteracts ground shadow.

The young, (two, three or four) much further developed than young rabbits, being covered with hair, with open eyes. Separate after a few days, though they may still feed together when the doe has left them, which is after about one month.

28. *Dogs*. 1. (*Vol. VIII.*, p. 504).

THE OLD ENGLISH SHEEPDOG is picturesque and intelligent, workmanlike and affectionate. Equally useful as sheepdog, sporting dog or companion. Though not often put to shepherding work nowadays, he can take charge equally well of sheep, cattle or New Forest ponies. As a sporting dog he makes a capital retriever, obedient, light-mouthed and taking readily to water. As a housedog his cleanly habits and affectionate nature make him an excellent companion.

THE COLLIE has a quick resourceful brain, and, though no longer used for sport, can be taught the work of a pointer, setter or water spaniel. He is a clever hunter with an excellent nose, a good vermin killer, a faithful watchdog and companion. He works best as assistant to a flock-master, farmer or clever, but is shy and slow to make friends with strangers.

THE ENGLISH MASTIFF came to England in the 15th century. He is still our most distinguished watchdog, because of his vigilance, ferocious aspect, deep penetrating voice, great weight of body and strength of limb. He is docile by nature, but can be roused to dangerous anger by unwarranted visitors.

THE GREAT DANE came to this country in the last century from his home in the Black Forest of Germany, where he is still used for hunting. He is really a mastiff, and his size—he stands three feet high—and his great determination make him a good watchdog. Usually faithful and friendly, but his occasional excitability combined with his great strength sometimes make him difficult to control.

29. Dogs. 2. (Vol. VIII., p. 512).

THE FOX TERRIER can be of one of two well-known breeds, the smooth-coated and the rough-coated. Both are still used for the original purpose suggested by their name—that of going to ground after a fox. Both are good for ratting, but the smooth-coated type is the better hunter. They are ideal house dogs, being smart and alert in appearance, usually very intelligent and able to adjust themselves to the moods of their master. Though very affectionate, they make excellent watchdogs, having great courage and tenacity of purpose. Good terriers should be black, white and tan; liver-coloured markings are not good.

THE AIREDALE TERRIER is at his best as a water dog, but he is also useful on land, being hardy,

strong, fast and resolute. His good nose, strength, sagacity and speed make him an excellent gun dog when trained. He is in fact a general utility dog, as useful as companion and guard as he is in the sporting field.

THE CAIRN TERRIER represents the oldest native form of British dog. Cairns were the original stock from which were bred all the varieties of game little Scottish terriers. They are active little hunters of vermin, affectionate, good house dogs and watch-dogs, and are cherished with great pride in their native land.

THE DALMATIAN is sometimes known as the "coach dog," from his fondness for living in and around stables and following the carriage or accompanying his master's horse at exercise. He is of a friendly disposition, of great personal beauty, and can be trained to remarkable cleverness.

THE SEALYHAM TERRIER is a smart plucky little dog, hardy and game and much more observant, tractable and easily broken in than is usually supposed. Sealyhams are good hunters, stand on short legs, and have a thick skin, a good rough weather-resisting coat, a strong wide head, strong jaws, and last but not least, a big heart in a flexible little body. They will provide many a day's sport for their owner and prove their worth in many ways.

THE ALSATIAN was known in England before World War I, but it was the excellent work done by these

dogs in the trenches in Flanders, where many of their exploits under fire read like fiction, that made them popular in this country. Brought home by returning soldiers, they proved such engaging and wise companions that many more were brought over. They attach themselves to one person only, to whom they show absolute obedience. They learn quickly, have a keen sense of direction and an unerring homing instinct. With their courage goes a surprising fondness for all young things, such as kittens, puppies, chicks or children, and an Alsatian will put up with treatment from a child which he would resent with dangerous anger from an adult.

THE BULL TERRIER is a cross between a bulldog and a smooth-haired terrier, and is a powerful dog famous for his courage and determination. Although not handsome, with his white coat and the suggestion of soreness about eyes and mouth, he is an ideal man's dog. Resenting being either pampered or neglected, he loves and obeys his master, and will fight to the death to defend him. He is a born fighter, but neither aggressive nor treacherous, and children are safe with him. He is considered to stand to-day to be the true national dog of England.

THE BULLDOG, one of the oldest British breeds, was once a surly, unsociable dog but with indomitable courage. Derived from the mastiff, till the 18th century he was used for bull and bear baiting. Close breeding has completely changed him to-day both in looks and character. For all his fierce appearance he is gentle and good natured, especially with children, but of

doubtful value as a watchdog. Although his fore-quarters show great strength he is often difficult to rear. The pug, the Boston terrier and the toy Bulldog, a French variety, all from the same stock, are much smaller in size and make excellent companions.

THE SCOTTISH TERRIER, or "Scottie," is a lovable game little dog, and a fine ratter. One of the hardiest of the domestic breeds, he keeps true to type and his shaggy body is always spruce and attractive. He is companionable, and a trusty guard. His teeth are very large for his size, a relic of the days when he hunted the fox amongst Highland crags.

30. Dogs. 3. (*Vol. VIII., p. 517*).

THE GREYHOUND is the oldest and most conservative of all dogs, is noted for his speed and is kept for coursing the hare. He takes naturally to this sport, and needs very little training. Greyhounds are bred and reared with an eye to their pace and stamina, and many are remarkable for fine muscular development and elegance of outline.

THE SHIPPERKE has an affectionate nature, but tainted with jealousy if the person to whom he attaches himself shows attention to anyone but him. Very inquisitive, he pokes his nose into anything, and the slightest noise arouses his curiosity. He moves with catlike agility, and his alertness, quick ear and musical bark together with his useful size and cleanly habits make him an excellent watchdog in the house. Follows well and is an excellent ratter.

THE CHOW, though descended from the Eskimo dogs, is imported from China, where he was often fattened for the table. Although too large for a toy dog his handsome appearance, with his deep ruff and proudly carried tail, makes him popular in English homes. His chief fault is his uncertain temper and pugnacity, which need careful handling, but he is loyal and companionable to his master and usually trustworthy with children.

THE DACHSHUND is sometimes jokingly called "the dog that is sold by the yard," but only by those who do not know his sporting character and the grim work which he is intended to perform. Dachshund means "badger dog," and in his native Germany he is trained to fight the badger in its lair. If properly trained, he can be used for all sporting purposes. His wonderful nose will pick up and follow through the coldest scent, and once fairly on the line he will give tongue loudly and cover the ground at an incredible pace. In the house he is a perfect gentleman, cleanly, obedient and unobtrusive. There are three varieties, differing only as to coat, which is short-haired, long, and rough-haired.

THE FOXHOUND was the first dog scientifically bred in Great Britain. During the Civil War under Cromwell the wild deer became scattered, and dogs swifter than the existing hounds were needed to hunt them. The first known kennel of foxhounds was bred at Wardour Castle, and is said to have been established in 1696. Improved breeding has produced perfect specimens, possessing beauty combined with power and the essential points for pace and endurance.

THE COCKER SPANIEL belongs to one of the most important groups of sporting dogs. The spaniel breed is very ancient, and varies in size from the massive Clumber to the alert little Cocker. Cockers have become popular in recent years because of their small size and merry and affectionate disposition, which make them good companions in house and field. They are very intelligent and easy to train.

THE PEKINGESE is the most attractive and original of all toy dogs, and owes his present popularity to his noble descent, his long history and the dignity of his character. He comes from China, where he is called the "lion dog" because of his colour. These dogs were very much prized, and were kept jealously guarded in the palaces of the Chinese emperors for three thousand years, exactly the same in type and character as they are to-day. No European had ever seen one till in 1860 the French and British forces entered Peking and sacked the emperor's summer palace. Five of the little dogs, left behind by the fugitives, were brought to England by Lord John Hay, and one was presented to Queen Victoria, who kept it at Windsor till it died ten years later.

THE ENGLISH SETTER is one of the most graceful and beautiful of sporting dogs, with his elegant form and feathery coat, and is of equal value as a gun dog or as a domestic companion. His proper sphere is on the grouse moor or among the stubble and root crops when partridge shooting begins in September. His coat should be mainly white or slightly flecked with blue. In some types patches of black, liver, lemon and

orange are seen, but these patches should never be heavy. They are possibly due to crossing with the *POINTER*, which itself is a cross between a Greyhound and a Foxhound.

31. **Birds that Help the Farmer.** (*Vol. IV., p. 160*).

The usefulness of birds to the agriculturist consists in keeping down the numbers of weeds and injurious insects by feeding upon the seeds, eggs, larvae, pupae and full-grown insects. Consequently any birds that dig in the ground or in tree trunks for these things, visit plants like thistles and cow-parsley for their seeds, or catch flies, butterflies and moths on the wing, may be regarded to that extent as useful. In some cases, e.g., blackbird, their usefulness is counteracted by their depredations among cultivated fruits, and it is not easy to collect accurate data to strike a balance. The birds shown can be regarded as beneficial.

1. *GOLDFINCH*. Recognised by broad gold bar on wing, red, black, and white head. About size of sparrow. Compact nest of roots, grass and moss built April-May. Eggs creamy, blotched red or purple. Migrant. Eats seeds of weeds especially thistle, and larvae.

2. *SWALLOW*. Distinguished from martin by forked tail and absence of white on back. Dark bluish plumage with red on head and white spots on tail feathers. Shallow, saucer-shaped, mud nest built under eaves. Migrant. Catches insects on wing.

3. *HOUSE MARTIN*. Body dark brown, except for white rump and underside. Mud nest under eaves,

half cup shape. Eggs whitish, early June. Second brood later. Migrant. Catches insects on wing.

4. *FLYCATCHER, SPOTTED*. Small, slim greyish-brown bird, faintly striated. Darts out from tree to catch flies on wing, and back to same spot. This habit more distinctive than any points in appearance. Loosely made nest of grass and moss built in walls, on trellis beams and about buildings. Dull white eggs with reddish spots laid early June. Migrant.

5. *LESSER REDPOLL*. A finch, similar to but smaller than linnet, with black chin, crimson forehead and crown. Nests in bushes or brambles in May. Nest small and deep, built with small sticks. Eggs deep blue-green with reddish spots. Resident. Eats seeds and larvae of insects.

6. *BLACKCAP*. Pale fawn with black cap, brown in female. Slim, about size of linnet. A warbler with very sweet song. Nest of grass and sedge built in thick bushes in late May. Eggs yellowish or reddish, mottled and clouded with deeper tint. Migrant. Eats insects, larvae and pupae.

7. *WREN*. Short brown body and tip-tilted tail. Mouse-like movements in hedges. Loud sweet song. Nest of grass, moss and leaves built at base of hedges and tree stumps. 3-10 white eggs. Resident. Eats insects in all stages.

8. *WHITETHROAT*. A warbler closely related to blackcap, of similar colour but V-shaped white patch

on throat. Nest near ground in low bushes or herbage. Eggs late May, greenish-white, speckled grey but variable. Migrant. Feeds on insects in all stages.

9. *COAL TIT*. About size of blue tit. Black head like marsh tit but distinguished from it by white spot on nape. Nest in holes in tree stumps, in disused rabbit burrows, always near ground. White eggs, spotted red, laid in May. Both migrant and resident. Searches for small grubs.

10. *PIED WAGTAIL*. Slender trim bird, size between thrush and sparrow. Grey, black and white, long jerking tail. Nest of moss, grass and roots built low down near water. Lays 4-6 eggs, bluish-white or brown, with yellow marks. Migrant, but some resident. Eats insects, searching ground chiefly.

11. *MEADOW PIPIT* or *TITLARK*. Like small skylark without crest. Light brown and speckled. Nests in upland fields and moors, slightly sheltered by tufts of grass. Eggs dark reddish-brown, closely speckled. Both migrant and resident. Insect feeder, searching ground.

12. *HEDGE ACCENTOR* or *HEDGE SPARROW*. Size of robin. Brown back, streaked darker. Light slate-grey on head and breast. Sweet song, constantly repeated and insistent. Is not a sparrow though commonly so-called. Another name is Dunnock. Nests in hedges, evergreen bushes, faggots or banks. Sky blue eggs in March or April, second brood later. Resident and partial migrant. Eats insects, especially weevils,

feeding on the ground in gardens under cabbages and other crops, and in hedge bottoms. Also eats seeds.

13. *TAWNY OWL*. A woodland bird, whose long, drawn-out, mournful hoot is heard at night. Warm buff colour, mottled dark brown, light bars on wings. Nests in hollow trees and holes in old buildings. Lays white eggs and is a resident. Feeds on mice and small voles which destroy grain.

14. *KESTREL* or *WINDHOVER*. Poises 20-30 ft. above earth, when silhouette shows wings projecting farther than end of tail. Slides along at same height, then moves off with slow, steady wing beats, searching a field systematically. Male and female often work together. Chestnut, with lighter barred breast and slate-blue head and tail. Commonest British hawk. No true nest. Eggs laid on high ledge, slight hollow or deserted nest of other bird, always high up. April-May. Both migrant and resident. Feeds almost entirely on mice and beetles, though pheasant chicks and small birds such as starlings will be taken if chance occurs.

15. *CUCKOO*. Larger than blackbird, with long slim body and very long tail. Slate-grey, breast lighter with dark bars. Lays one egg per nest of other birds, choosing as hosts, birds much smaller than itself, e.g., meadow pipit or hedge sparrow. Migrant. Eats caterpillars and leather jackets in large quantities. Is one of the few birds to eat hairy caterpillars.

16. *PEEWIT* or *GREEN PLOVER*. Known also as the Lapwing, it is about the size of a pigeon. Striking

crest and rounded, flapping, black and white wings. Glossy green back, with chestnut above and below tail, can be seen at close quarters. Wheeling flight. Nests from March onwards on ground in ploughed fields, grass, moorland, or any open site. Resident, but many winter arrivals add to the number from other lands. Is very beneficial as an eater of wireworms, leather jackets, snails and slugs.

32. Birds of Doubtful Character. (*Vol. IV., p. 165*).

The injury done by birds to crops, or by birds of prey, is usually only of importance if those birds occur in great numbers. For instance, starlings, from being extremely useful insect feeders, seem to have been forced by the extraordinary increase in numbers in recent years to change their feeding habits and have become a menace to fruit growing, especially in apple, pear and cherry orchards, and also to cornfields. The gregarious habit, too, increases the trouble. On the other hand, where pests of insects arise they may be invaluable; e.g., in Bavaria, 1889-91, nun moths were a plague and flocks containing as many as ten thousand birds were seen feeding on the larvae and pupae (Ministry of Agriculture Leaflet No. 208). The problem, therefore, is how to keep the right balance, so that particular birds do not increase to such an extent that they begin to feed extensively on ready-made (man-provided) foods. In this series both the harmful and beneficial characteristics of some well-known birds are noted briefly.

1. *HOUSE SPARROW. Against.* Large proportion of food is cultivated grain, especially just before harvest. Damage garden produce, e.g., pull up young

peas. Strip buds of currant and gooseberry bushes, tear brightly-coloured flowers such as crocuses. Eat young carnation shoots in winter. Damage ricks and thatch. Block drains, pipes and gutters with nests. Drive away useful insect-feeding birds such as martins.

For. Eat seeds of weeds. Feed young on aphides, caterpillars, larvae and adult beetles, crane-flies. (To some extent adults feed on these).

They are thus most injurious in corn-growing country but welcome only in limited numbers anywhere.

2. *GREENFINCH*. (Sometimes called "green linnet.") *Against.* Does considerable damage to crops, especially through digging up seeds in gardens before they have time to germinate.

Numbers need to be controlled near cultivated land.

For. Feeds on insects and larvae and feeds young on these. Feeds on seeds of weeds.

3. *BULLFINCH*. *Against.* Has a pronounced liking for fruit buds, and destroys far more than it eats, hence is injurious to orchards and gardens in spring. This *outweighs* good done, particularly in fruit-growing areas. It would be a great pity, however, if these, the handsomest of the finches, were exterminated, but control is often desirable.

For. Feeds on seeds such as groundsel, chickweed. Probably does not do much harm to cultivated fruits, as its preference is for berries, such as wild rose, hawthorn and rowan.

4. *HAWFINCH*. *Against.* Has a great liking for damsons and cherries, especially the stones, which it cracks with its powerful beak.

Not common enough to be a menace, but does considerable damage to fruit and is especially fond of peas. Should not be allowed to become too prevalent, but is at present rare in many places and rather local in its distribution, though it is said to be increasing and extending its range.

For. Feeds young on insects and their larvae.

5. *STARLING. Against.* The flocks are the great menace as they can easily ruin a crop, for instance of sprouting grain. Destroy considerable quantities of fruit. Are on increase and need to be strictly controlled. Grain as well as germinating plants taken. Are seriously suspected of the carriage of foot and mouth disease from contaminated districts on the continent.

Definitely injurious.

For.—Their large flocks will clear whole areas of the kinds of insect which are also likely to appear in large numbers; e.g., cockchafers, leatherjackets, certain moths, which have surface caterpillars ("cutworms").

Help to keep down the external parasites of sheep, such as ticks, by pulling them out of the wool or skin. The food of 40 nestlings examined contained 89% injurious insects. (Ministry of Agriculture Leaflet No. 208.)

Would be *valuable* if *numbers* considerably reduced.

6. *SPARROW HAWK. Against.* In killing the small birds which are insect-feeders, this low flying hawk is likely to promote the increase of insect pests. It raids chicken runs at times. It will also eat frogs, which are useful in keeping down insects, slugs and snails.

For. In so far as it kills sparrows it does useful work, and mice are also among its victims. Careful observers say its attacks upon game chickens are very few. On some districts from which it has been banned a great increase in injurious small birds has been noticed.

7. *WOOD PIGEON. Against.* Unquestionably the most injurious of all British birds, all the year round.

A constant succession of crops is attacked, at all stages from germinating seeds to fruits. Examples—wheat, oats, beans, peas at all stages; cabbages and rape, sometimes ruining a crop in winter; buds of trees; potatoes; clover leaves; tops of turnips, while roots are holed; fruit such as cherries, currants and gooseberries.

For. Weeds such as dock and chick-weed, but not enough to balance depredations.

8. *JAY. Against.* Takes a good many eggs and young of other birds, including game, and is fond of garden produce, especially beans, peas and soft fruits.

For. Feeds on insects, slugs, mice. On balance probably beneficial rather than otherwise, though it would be difficult to convince gardeners and game-keepers of this, as its good works are less in evidence than its bad.

Essentially a woodland bird, only visiting gardens and fields near woods.

9. *JACKDAW. Against.* As *Jay*. Egg thief, will visit poultry yards.

For. As *Jay*. On the whole beneficial in destroying many agricultural pests, provided numbers are not too great.

10. *MAGPIE. Against As Jackdaw.*

For. As Jackdaw. Rather helpful on the whole.

11. *CARRION CROW. Against.* Omnivorous in feeding, will take hen's eggs and young chicks, as well as young game-birds, hares and rabbits. Actually eats little carrion. Its destruction of eggs and game renders it a nuisance, and its crimes outweigh its good deeds, especially to poultry farmers.

For. Will take rats and mice and insects.

Hunt in pairs, and can be distinguished from adult rooks by the feathers coming right to the beak; in the rook there is a bare patch just above.

12. *ROOK. Against.* Undoubtedly takes a good deal of grain and to some extent attacks other crops, such as potatoes and roots.

For. Takes a great deal of insect food from the soil, especially leatherjackets, cockchafers and caterpillars which injure crops.

The problem is again one of numbers, and varies in different districts and at different times. The competition of starlings has probably driven rooks to take more agricultural produce and their control might put matters right for the rooks by giving them more supplies of their natural foods. In moderation they are definitely friends of the farmer.

13. *GREY or HOODED CROW. Against.* A local winter visitor, coming to the east coast of England, and all over Scotland and Ireland from Europe. Its habits are much the same as the carrion crow's.

It is a great egg thief and destroyer of game. T. A.

Coward mentions that it is feared and hated on the sheep runs.

For. Although its record is undoubtedly black, it does act as a scavenger on the coast, feeding on fish refuse and other decaying matter.

It would be a pity, however, to exterminate an interesting visitor, though it undoubtedly needs to be strictly controlled.

14. *THE LITTLE OWL.* *Against.* Not a native of Britain, but introduced by several people from 1840 onwards, began to establish itself and nest in the Midlands and southern counties. Although regarded by gamekeepers and farmers as a pest among chickens and game, its pellets show that its food is chiefly small mammals, beetles, earwigs and daddy-long-legs. It is exceptional amongst owls in being diurnal, and may often be seen flying in the afternoons. Length only 9 in.

For. A much maligned bird. Controlled, it probably ranks with the helpful varieties. A report (1938) by the British Trust for Ornithology, after scientific investigation, shows that out of 2,640 pellets examined, only one game chick was found.

33. Water and Marsh Birds. (*Vol. VIII., p. 484*).

1. *PUFFIN.* One of the auks, sometimes called Sea Parrot, from shape of beak and staring eyes. Spends most of its time floating on the surface of the sea, off rocky, inaccessible coasts on which it nests. A small, dumpy bird but an excellent diver, swimming under water by using its wings. Top of head and back black, rest white. A large, broad (but *not* hooked) beak for

catching slippery fish. This is striped vermilion (or orange) yellow and greyish blue, so is very striking. The eyes are surrounded by a crimson rim, with a band of steel-blue above and below, helping to give it a fixed, solemn expression. The beak becomes smaller and duller in winter. The legs are vermilion or orange. Summer visitors, chiefly to our northern and western coasts, going further south in winter. A single egg laid in a deeply excavated burrow—sometimes an old rabbit burrow.

2. *CORMORANT*. Although a gregarious bird, breeding in large numbers together, is frequently seen sitting alone on a rock or post, in harbours, estuaries, or by seashore, very upright, then diving and swimming under water to come up a long distance away. Very voracious feeder. In the distance, as usually seen, looks black, but has a white throat, while a white patch on the thigh and hair-like white feathers streaking the head and forming a crest, appear in spring. Long, straight beak is slightly hooked at tip. Flight is very characteristic, for it skims along almost touching the water, rising very clumsily and heavily. The young feed by pushing their heads right inside the crop of the parent, eating partially digested fish.

3. *GANNET*. Sometimes called the Solan Goose. A large, heavily built sea-bird, white with fawn head and neck, and black primary flight feathers making black wing-tips. Feeds entirely on fish, following shoals of herring, sprats and others that feed near the surface. Frequents our waters gregariously all the year round, breeding in strictly localised spots, of which the Bass

Rock ' is best known. Flies powerfully and dives from great height, wings closed, with great force and precision. Large head, legs set well back as in all diving birds, long, sharp beak. Young birds, as in many sea-birds, e.g., gulls, much darker than adult and mottled.

4. *HERRING GULL*. Much larger than the Common Gull and Black-headed Gull, otherwise similar in general features. Plumage blue-grey, with black outer primaries, and lower parts, head and tail white. Follows shoals of herrings, but also feeds on shore, following the tides. Hunts for garbage with crows and ravens and acts as a scavenger. May be seen in hundreds, fighting for share of offal when herrings are being gutted, together with other gulls. Also takes eggs and young sea-birds. Nests on high ledges on rocky shores, or on low islands that are sufficiently isolated, laying three mottled eggs, olive-brown with dark brown spots.

5. *BLACK-HEADED GULL*. Our commonest gull, seen inland 50 or 60 miles from the sea as well as on the coast and estuaries, especially in winter, when it frequently follows the plough. A little smaller than the Common Gull, differing from it in having a dark brown (not really black) cap or hood in the summer, and in having reddish-orange bill and feet instead of greenish yellow. Plumage blue-grey above, white below. The common gull has black-tipped wings, due to black primaries. The head looks quite black at a little distance. As winter advances, this fades, so that a smudge in the region of the eye is the only indication, and later this too disappears. Breed in salt marshes, returning year after year to the same spot. Eggs

variable, pale blue or green to olive-brown, mottled with dark brown to black.

6. *THE COOT*. Closely related to the Moorhen, the coot is rather larger, has a distinct white patch on the forehead instead of red, and lacks the red colouring of the upper part of the legs. It is plain dark grey above, black below, with dark green legs and feet. The white patch on the forehead may be remembered as its "signature."

Habits much the same as Moorhen, for it frequents reedy, stagnant pools and slow, marshy streams, nesting in reeds. In the winter, however, in the north and north-west it frequents estuaries and mudflats, e.g., the Mersey.

7. *DABCHICK*. This is a charming, vivacious little bird, which gets its living by constantly bobbing under the water in search of small fish and other creatures, reappearing some distance away. It is fawn, dusky and reddish brown in colour and at first sight suggests a duckling, but its body is short and head almost round, with a short beak. Its other name is Little Grebe. It will be found in much the same places as the Moorhen, and often appears on ornamental lakes.

8. *MOORHEN*. In the distance, seen swimming on mere or stream, it looks black, but at close quarters is slaty black with dark brown wings. On the water it frequently raises its tail, when white covering-feathers can be seen on the underside, and there is a white patch on each flank. The beak is bright scarlet, continued into a shield-like patch above it. The legs are

yellowish-green, with remarkably long toes, not webbed, but with a slight extension of skin. The birds swim with a jerky movement, dive and swim under water, and walk and run jauntily but a little clumsily on land. The name is said to be a modification of "mere-hen," and it is also called the water-hen. Nest built on low vegetation over water usually. Eggs 6-10, buff spotted with purple and red. The young are extremely agile from the first, excellent divers and swimmers, will slip into the water from the nest and scramble back again. An interesting point mentioned by Mr. Coward is that the wings of the nestling are provided with a claw, which is used to help them in scrambling. This claw (also found in young chickens) is thought to be a relic of their reptilian ancestors.

9. *COMMON SANDPIPER*. A very trim, elegant little wading bird of streams and lakesides, brownish in colour, having darkish green-brown back, streaked lighter breast, and white chin and under parts, also a white wing-bar that shews in flight. It is a summer visitor, whereas the other sandpipers are autumn visitors. Arrives about April, nests near water, in low bushes or brambles amongst grass, laying four speckled buff eggs in May, and after rearing a brood, leaves the country again to go south in August. A migrant in the southern counties but common in Wales, Scotland, Ireland and the northern counties of England. Characteristically a bird of the hills and uplands, where it shares streams with dippers and wagtails, but preferring the sandy stretches. Flight characteristic: rises and wheels in a semicircle, with strong beats and sharp down strokes with a quiver of the wingtips. As it flies,

gives a sharp call of four quick notes, repeated two or three times. T. A. Coward gives the local name Kittie-Needle as resembling the call. Feeds on small crustacea, insects and worms.

10. *SNIPE*. A bird of marshy moorland, the wading type, with rather long legs and a long, very sensitive bill with which it probes in mud for worms. Hence it cannot feed in frosty weather, and must change feeding grounds. Streaked brown, buff and white. It is a resident, but some winter visitors and migrations have attracted widespread attention. A small number of birds flying together called a "wisp." Takes cover during the day, and flies at dusk. When disturbed, dashes into the air and then makes a zigzag flight, which distinguishes it from the slightly larger Great Snipe, which rises quietly, and from the smaller Jack Snipe. During courtship, and perhaps at other times, adds to its display flight a peculiar drumming like a bleat, which is made by the wind passing between the outer tail feathers. The display flight is well-known, the male rises to a great height, then shoots down with great violence, performing all sorts of "stunts" as it drops.

11. *TUFTED DUCK*. One of the smaller ducks, often seen on ornamental waters. The plumage of the male is striking, black above, white underneath, prominent tuft or crest (not always raised, however) and bright gold eye (not to be confused with the bird called the golden eye). The female and young are dull, dark brown. They have the habit of frequently diving, popping up again after a few seconds, which also attracts notice. Chiefly winter visitors. Fresh water only.

12. *OYSTER CATCHER*. A wading bird frequently seen on our west and north-west coasts, where it nests freely, but more rarely on the east. Sometimes called the Sea-pie from the black and white plumage, black back, neck and breast, and white underparts. It has bright scarlet legs and beak, and blood-red eyes. It is about the size of a black-headed gull, with much the same proportions except that the bill is longer. In winter there is less black about the neck. Very variable in its choice of nesting site, but usually near the shore, on the ground, on pebbles, turf or amongst rough grass. Three yellowish, blotched eggs.

13. *THE GOLDEN EYE*. There is often some confusion between the golden eye and the tufted duck, since both have golden eyes and black and white plumage, and both are divers. However, the male golden eye is a larger bird, has a distinct round white spot at the base of the bill, and outstanding, bristly feathers on head and neck which make the head look large and the neck thin; the head is green and glossy. The female is dark brown above, without the white face-spot, and white below, and the immature birds grey. A winter visitor, not gregarious as are the tufted ducks. Also kept on ornamental waters, e.g., in London parks. Note that in summer the plumage of drakes of all kinds resembles ducks'; there is a gradual transition to the winter (mating) plumage, which is moulted after the mating season.

14. *PINTAIL*. Another very handsome duck seen in parks, and fairly common on the south coast as a winter visitor. A slender, very graceful bird, with a dainty head, slim neck and two tail feathers drawn out

to a fine point. Occurs in small flocks, frequenting shallow water, especially near the shore, where a muddy bottom provides it with small crustacea and insects. Head bronze, with black nape, separated from the rest by a narrow white stripe down each side, broadening to merge with the white of the breast and under parts. Back and sides delicately pencilled grey, tail black. Wings fawn, with green speculum (the more or less oblong patch often seen in ducks' wings) edged with black and white. Female, less striking; mottled brown above and lightish grey-white below. Legs and bill grey. Occasionally called Sea Pheasant.

15. *WIDGEON*. A small very neatly marked duck; general impression of colouring of drake is white and delicately marked grey, with chestnut neck and throat and green speculum. Wing and tail feathers and legs dark brown, bill dark blue. Female, mottled grey and brown with green speculum. One of the most familiar wild ducks, both by the sea and inland in winter, more abundant by the sea. Resembles geese in feeding on grass on land, but also feeds in the water, both by day and night. Has a high, whistling cry when in flight.

16. *MALLARD*. The common wild duck. Glossy green head and neck, with a white ring, then chestnut extending over hind, neck and breast, changing to greyish-white under parts.

Wings grey and black, with purple speculum shot with green and edged with white. The duck is smaller and more drab in colour, with a dark brown head, and has a green speculum. Resident, but numbers are winter visitors from farther north.

34. Goldfish and Queensland Salmon. (*Vol. II., p. 45*). The possible development of the legs of land-dwelling vertebrates from the paired limbs of fishes.

Fishes are the lowest of the animals which possess an internal skeleton and backbone and their swimming organs, fins, are their substitute for limbs. There are two pairs of these fins, besides several unpaired ones, consisting of thin skin supported by bony rays. Certain fishes such as the Queensland salmon of Australia have taken to supporting themselves on the paired fins when the rivers dry up, waddling about in the mud, and it is this which has suggested the possibility of the evolution of legs from these paired limbs of fishes. If the limbs of the higher animals are studied, it will be seen that their structure has a very definite relation to the way in which they are used, and that this in its turn is closely related to the way the animal obtains its food.

35. Seaweeds. (*Vol. VIII., p. 485*). Seaweeds are amongst the lowliest plants which exist. They do not produce flowers, but throw out either minute eggs or "spores" into the water, sometimes able to swim actively, and from these new plants grow.

The plants are not distinguishable into true roots, stem and leaves, but consist of a thin, platelike or ribbonlike tissue called a thallus, often branching profusely, and sometimes having leaflike or stemlike portions. Most of the seaweeds are attached to rocks, stones or shells, or wooden posts and groins, in many cases by means of thick cords or a disclike holdfast. This is not a true root, for it does not absorb water.

All seaweeds are submerged, but many of them grow between high and low tide marks, or in rock pools, so

that they are exposed to the air for many hours at a time, while others grow only in deep water. They all contain chlorophyll but in many it is masked by some other colour, so that they appear brown or olive-brown, red or purple.

As most seaweeds can only be identified by experts, few have popular names, and hence the necessity for using their scientific names.

1. *COMMON BLADDERWRACK*. (*Fucus vesiculosus*). The best known of all seaweeds, the tough-looking, branched, olive-brown seaweed which occurs between the tide-marks on rocky shores, wharfsides and piers, bridges and artificial banks of some tidal rivers. It has a double row of oval bladders which explode on pressure, along the fronds and also at the tips of the branches. The branches repeatedly fork into two, and there are well marked mid-ribs. This is the chief source of kelp gathered by shore-dwelling people for the making of iodine.

2. *SERRATED WRACK*. (*F. serratus*). Found in similar situations, about half way between high and low water, a close relation of the bladderwrack, but has a sawlike edge and no bladders. It is not nearly so slippery and slimy, and since it does not tend to ferment but keeps cool, is much used for packing fish, lobsters etc.

3. *KNOTTED WRACK*. (*F. nodosus*). Very narrow, strap-shaped fronds, with bladders at frequent intervals. Used as manure (as are most of the wracks) and to some extent for kelp. It is chiefly among poor peasantry that seaweeds are used, e.g., in the West of Ireland and the islands off the Scottish and Irish coasts.

On the unfashionable end of the Lido, which is a long line of sandhills with practically no natural resources, potatoes are grown in the sandy hollows, manured by seaweeds, and so eventually soil is established.

4. *RIBBONWEED* or *TANGLE*. (*Laminaria digitata*). Also called Oarweed. The broad, smooth, brown seaweed used as a weather indicator, since it dries in dry air but absorbs moisture and so becomes moist when the atmosphere is saturated with water-vapour and rain is probable. Deep water, below low tides. Near the shore grows in single strips, 3-4 in. wide and perhaps 1-2 yards long, but in deeper waters is much broader and has numerous branches, spreading out in a great fan-shape many yards in extent.

5. *CORDWEED*. (*Chorda filum*). Another brown seaweed, like boot laces; round, smooth cords. Deep water, not exposed. A relation of the tangles.

6. *SEA LETTUCE*. (*Ulva latissima*). Also called Green Laver. Between half and high tidemarks, and in rock pools, attached to stone. Spreads out a circular or fanlike frond which is not divided, but much crinkled at the edge. Delicate texture and bright green colour. Excellent for supplying oxygen in a marine aquarium. Variable in size but never very large. Edible if slowly stewed, gathered for this purpose in winter.

7. *SEA GRASS*. (*Enteromorpha compressa*). Long, hollow green tubes, forming dense hanging matlike masses, like grass. Same situations as sea lettuce, in fact both plants can live satisfactorily if submerged for a few hours daily.

8. *CORALLINE*. (*Corallina*). Small pinkish or bleached-looking tufts, encrusted in lime, giving it a hard, jointed surface which suggests a coral. It is, however, a plant. Usually grows in dense tufts 3-4 in. high, in the shelter of rocky ledges or under the wracks, near low water mark.

9. *DULSE*. (*Rhodymenia palmata*). This is one of the red seaweeds. Esteemed as edible on the coasts of Ireland and Norway. Also given to sheep, and so known as Sheep Seaweed.

10. *CHYLOCLADIA ARTICULATA*. A red seaweed interesting for its form and beautiful clear, claret-colour. Described by Rev. I. G. Wood as looking like "a jointed series of transparent bottles filled with claret or other red wine." 8-9 in. high, branched and thus jointed. Related to the preceding seaweed.

11. *ECTOCLARPUS SILICULOSIS*. A dainty, feathery-looking seaweed, the appearance being due to the exceedingly fine and close branching of the thallus. Given as an example of a quite different form. There is no popular name, but the scientific name indicates that it has "external fruits" which are minute pouches. These can be seen with a good lens. Its fine tufts, 2-3 inches long, may be seen in rock pools and deep water.

12. *CARRAGEEN MOSS* or *IRISH MOSS*. Interesting because at one time the chief source of isinglass for making jellies and thickening soups; also used for sizing printed calicoes. Eaten by Irish peasants

and used as fodder. At one time thought to be very nutritive, and fashionable for invalids. A pretty seaweed, with a fan-shaped thallus deeply divided and subdivided. Very variable in colour, from reddish-green to green or yellowish-green. Common on rocky coasts.

13. *RHODYMENIA BIFIDA*. A pretty relation of dulse, small but of bright conspicuous red. About 2 inches high, with fronds $\frac{1}{4}$ in. wide. Growing on rocks or on other seaweeds. Thallus forks repeatedly and has bluntly-rounded tips.

14. *POLYSIPHONIA URCEOLATA*. Can be recognised because when taken out of the water it does not collapse, but remains rigid. There are many polysiphonias; the name meaning many tubes, describes their structure, for though fine and threadlike in appearance, on cutting a section and examining it with the microscope the frond is found to consist of several tubes closely united to one another. The fronds are also jointed, a point which may be ascertained with a lens. They form a dense reddish mossy growth on rocks or on larger seaweeds, about low-water level.

15. *PLOCAMIMUM COCCINEUM*. A small red seaweed that is like a bush in miniature in that it grows out in all directions from several stems branching so that it has a very twiggy appearance. Its smallest twigs shew still finer branching, arranged like the teeth of a comb, on being examined with a lens.

16. *CLADOPHORA RUPESTRIS*. A very common green seaweed of rock pools or hanging from rocky

ledges where it has been left dry. Not pretty, but unusual in appearance, like thick tufts of dull green or blackish horsehair, not more than 4-5 in. long. When the sea covers it the colour is brighter and fresher.

36. Univalve Shells. (*Vol. VIII., p. 486*). Molluscs are soft-bodied creatures usually protected by shells, though occasionally the shell has been lost, e.g., Octopus, Slug. An organ called the shell gland manufactures the shell, which is hardened by carbonate of lime. Most of the molluscs are water-dwellers. The shell may be in one piece (univalve) or two (bivalve).

There is a wide range of habit and habitation amongst the molluscs, and details of structure and shape, both of shells and body, are found to have close relationship to the kind of life they live.

Most of the shells figured are common ones which are washed up by the tides on to our sandy shores, but few of the animals live in these situations.

On the whole the occupants of univalve shells are more active than those of bivalves, and so it is usual to find they have a well-developed head, with feelers or tentacles, horny jaws and a rasping tongue, that is, a band of tissue provided with many rows of minute teeth. There is generally a well-developed foot, usually with the head attached to its upper side.

COWRIE. Only very minute cowrie shells are found in British seas; those which are commonly used as counters come from tropical seas. But if search is made in rock-pools or amongst the stones at low tide, they may be found hidden in crevices of the uncovered rocks, or gliding about in the water. They are at most

$\frac{1}{4}$ in. long, oval domes with a hard, glossy surface, and on the under side, there is a long slit from end to end, with the edges turned in. Inside the minute shell, greatly compressed, is a foot which can be expanded till it is twice the breadth of the shell, and a head provided with long tentacles and a long feeding and breathing tube, like the siphon of a bivalve, into which both a current of water and tiny particles of food can be drawn. In addition, the mantle is extended right over the shell in a fold from each side. Its colours are very bright, for the mantle is olive green edged with red and speckled with black, and the tube and tentacles red. It feeds on the colonies of Sea Fir and other tiny sedentary animals which clothe the rocks in sheltered positions.

KEYHOLE LIMPET. Smaller, narrower than the common Limpet, and less frequent, this animal owes its name to a slit in the top of the shell, which makes the whole thing look rather like the oval plate which surrounds a keyhole, although it is a shallow dome, not flat. It is found in much the same situations as the common species.

COMMON LIMPET. The hard, dull, greenish or brownish tent-like shell clinging tightly to rocks and groins, is well-known to every one. It only becomes active at night, when it raises the shell slightly to project its disclike foot all round, and moves off to its feeding-ground. At the front end is a broad, short head, a pair of short tentacles and a mouth, provided with a long ribbonlike rasping organ. With this it bites off seaweed against its horny jaw, and rubbing it against

the rows of hooked teeth, breaks it into small fragments which can be swallowed. Before daybreak it returns to the same resting place as before, and settles down on the rock, fitting into its former situation so exactly that in the course of time a shallow pit is worn, the edge of the shell coinciding with the rim.

It is noteworthy that a number of molluscs seem to have a very good sense of direction. The homing instinct is marked in the Garden Snail, which sets off to feed at night, and returns by the same track at daybreak.

MAIL SHELL. Only small species of this mollusc are found on British shores, but very much larger tropical forms exist. The commonest British one is mottled grey or brownish grey, with tufts of stiff bristles projecting from the sides. Its name is due to the structure of the shell, which covers the upper side of the body only, as in the limpet, and consists of eight narrow transverse plates, fitted together so that they form a shallow roof with a ridge along the middle. In hunting for them at low tide it is necessary to search crevices and under half-buried stones, for they hide away very completely when the tide has uncovered them. If touched when gliding about on the bottom of a pool, or if detached from a rock, the mail shell promptly coils into a ball, exactly as a "Pill-louse" does. In this way the whole body is protected by its suit of armour. It has no head. Another name for it is Chiton.

TUSK SHELL. An inhabitant of deep water, though shells are found washed up on our shores. Very brittle, hence unusual to find a perfect one. The

Smooth Tusk (northern coasts of Britain) is white and polished, the Grooved Tusk (south coast) is finely striated and suffused with pale pink. It buries itself completely in sand, feeding just at the surface, under water, so it neither needs nor possesses eyes or tentacles. Up to 2 in.

TURRET SHELL. Empty shells very common; long slender spirals tapering to a fine point. They are deep water forms. Biscuit colour or ash grey with a matt surface.

TOP SHELL. Also very common. Broad cone-shaped spiral, shape of a top. Colour variable, sometimes very bright. Living animals found at low water on seaweeds, on which they feed like snails. They are very much like snails, having a head, tentacles and broad foot, but in addition wide edges of the mantle project as lappets at the sides. The most common are coloured in bands or chocolate and white, purple and white, or slaty-blue and reddish-brown, rather like the banded snails of the hedges.

RIBBED SPINDLE. Very like the top shell, but the whorls have raised ribs across, following the lines of growth. In all these spiral shells, growth takes place from the edge of the mantle, at the mouth of the shell by means of narrow layers of lime laid on to the preceding ones. If a shell is broken, whatever part of the mantle is exposed can repair it, though only roughly and irregularly.

WENTLETRAP. This, or Ladder Shell is very like a turret shell in shape, but broader and having

well-marked ribs running transversely to the whorls. The whorls, too, are more rounded and distinct. It is a deep water form, living in the sandy bed of the sea, and if disturbed squirts out a purple fluid. It is of the same type as the top shell, having a fairly large, broad foot and well-developed head, tentacles and eyes. The shell is thick and milky white.

DOG-WINKLE. This has a thicker, heavier-looking shell than the Periwinkle with a more elongated spiral, ending bluntly. It is a dirty cream or drab colour.

ROUGH PERIWINKLE. Smaller than the common Winkle with a roundish, roughened shell and a bright band of rich colour on a paler ground following the spiral. Variable in colour.

PERIWINKLE. This needs no description, the dark slate-blue or greenish shells are well-known. It feeds on seaweeds, like the top shell. Like most of these spiral univalves, it breathes by means of small tufted gills inside the shell, and provided these can be kept damp, it can remain for hours out of water. It can close the mouth of the shell by means of a horny plate (operculum) attached to the foot, which fits exactly into the opening when the foot is withdrawn. So, too, can the top shell.

DWARF PERIWINKLE. Not only smaller than the foregoing, but much flatter, due to the first turns of the spiral being both small and flat, so that they lie close against the large outermost whorl.

DOG-WHELK. The shell is common, thrown up on our shores, and the living creatures can be readily

found at low water on groins and breakwaters, or crawling on sand. Like the larger, true whelk, it feeds on other molluscs by drilling a hole through the shell to get at the contents. Periwinkle, limpet and other shells may often be found with a neat, round hole in the side. The dog-whelk is famous as being the source of the ancient Tyrian purple dye, so highly valued in the past, a dull reddish-brown purple which is not now regarded as attractive. The netted species shewn has transverse ribs on the whorls, connected by finer ridges which divide the whole surface into small squares. The colour is very variable, cream, yellowish, greyish or brown, sometimes banded with brighter colours. In texture it is thick and rather rough. The foot is broad and yellow. It has eyes, tentacles and a long siphon which it carries extended.

WANDERING POND SNAIL. This creature may be known by its very short spiral and large outer whorl. It is rather local, found in stagnant or slow streams, ditches and ponds, feeding both on vegetation and on decomposing animal matter. The name comes from the habit of wandering away from the water into damp meadows. It breathes atmospheric oxygen (like a land snail), drawing it into the large whorl of the shell, part of which (lined by the mantle) acts as a lung. It is regarded as having returned to water after having become adapted for existence, and particularly breathing, on land.

RIVER SNAIL. Really a fresh water winkle, it breathes in the same way, by means of gills, and is able to close the shell by an operculum. This and its

allies are viviparous (born alive), that is, the eggs are not set free, but having hatched, are retained in the body until a fairly late stage of development, when they are set free a few at a time. Three dark bands run spirally round the body whorl, on a lighter yellowish ground. The body whorl contains not only the breathing chamber but also the greater part of the body, the other whorls being occupied by parts of the viscera.

MARSH POND SNAIL. Related to the common pond snail, but smaller and narrower, and therefore more elongated in appearance, approaching the shape of a turret shell. The shell is also browner and thicker.

RAMSHORN SNAIL. The coils of the shell lie all in one plane, so that it is flat. There are many different species, common in fresh water almost everywhere. There is a small, short foot, and one pair of long, thin tentacles, having a pair of eyes at the base. Feeds on pond weeds. This type or Common Trumpet Snail is about 1 in. in diameter, and dark reddish-brown in colour. When crawling it holds the shell clear of the body, having its diameter at right-angles to the surface; a long "neck" enables the shell to swing freely and easily as the snail turns through an angle to reach a different position.

37. Bivalve Shells. (*Vol. VIII., p. 487*). In the bivalves two valves or halves are hinged together by one or more strong bands of muscle passing from one to the other. Dull, roughened patches in empty shells usually shew the place of attachment of these muscles.

The body is enveloped in a fold of skin forming the lining, called the mantle, of which the shell gland is

a part. Bivalves breathe by means of delicate plates of soft tissue, made up of a meshwork which contains much blood. Water is drawn into the mantle cavity at an opening between the two closely-adherent halves of the mantle, the inhalent. It is whipped round the cavity by fine motile threads called cilia, outgrowths from the mantle and gills. This current of water bathes the gill-plates, which are able to extract oxygen from it by means of the blood they contain, at the same time giving up waste carbon dioxide. The water then passes out again by a second opening, the exhalent, often placed close to the inhalent.

From this current of water minute organisms are also obtained as it passes the mouth. Most bivalves are more or less sedentary; the great development of gills is connected with this habit, which is also accompanied by loss of sense organs, head and jaws. Most molluscs are provided with a strong, muscular organ of locomotion known as the foot. This may be used for gliding (snail, limpet), burrowing (cockle) or even jumping (cockle). It is missing in a few forms (oyster) which remain attached to one spot.

Most bivalves live partially or wholly buried in mud or sand, often in deep water. Short or long siphons, bearing the inhalent and exhalent openings at the free end, then project to the surface of the mud into the water. Where the animal lives between tides, (cockle) these are withdrawn, the shell is closed and completely buried.

ASTARTE. A shell of strong substance, in which growth takes place from a small, pointed nucleus or umbo, by the addition of smooth ridges which follow

the shape of the shell. Pale pink, yellowish-pink or nearly white. Common. Similar shape to a cockle shell. Burrows in sand.

SUNSET SHELL. An oval shell, finely striate from umbo to lip. Lines of growth fine, not thrown into ridges, but alternate deeply coloured and light bands of rosy pink are broken by pale rays, suggesting sunset rays. Burrows in sand.

ROUGH TELLIN. Similar in shape to sunset shell, but umbo projects slightly and one end more pointed than the other. Bright pink or yellowish-pink with alternating bands of colour following growth lines. In spite of name, not very rough. Thin and slightly translucent. Burrows in sand.

SAND GAPER. The rough white shells are often thrown up separately, but whole shell explains the name, for there is a gap at the more pointed end from which the siphon projects. The creature burrows in muddy shores and estuaries, exposed at low tide, and often sends up a jet of water if one walks over its burrow. It has a long, wrinkled siphon, with two openings (actually two tubes enclosed in one wall), and both shell and siphon are covered by a dark, loose skin, while the siphon ends in a pale-coloured frill.

COCKLE, ROUGH. Differs from common cockle only in having a more deeply fluted shell, with minute roughnesses on the radiating ridges, but more striking in consequence. Burrows in sandy shores, to a depth of 18 in. or more if disturbed, but when tide is high,

lies just beneath the surface of the sand, with two very short siphons protruding. A broad, curved foot enables it to burrow and to leap along the surface.

All the burrowing molluscs seem to be aware of the returning tide. The burrowing habit serves both to protect them from the force of the waves, which might batter them to pieces, (as the empty shells are broken) and to prevent their being washed out to sea. Note that a great many sea creatures are armoured against the force of the sea quite as much as against living enemies.

SCALLOP, VARIEGATED. Usually only comparatively small scallop shells are washed up on beaches. The small, almost flat, fan-shaped shells are finer in texture and marking than cockle shells, and each valve has a flat triangular flange on either side of the umbo. They are deep water forms. One valve, deeper than the other, contains the body, while the flatter is uppermost and forms a lid. Young pectens swim freely by clapping the shells together. The fringed edge of the mantle bears a number of minute black pigment spots or eyes which are apparently sensitive to light, while the fringe is sensitive to contact. Note that with active movement is associated higher sensitivity.

TROUGH SHELL. Similar shape to a cockle shell, but without fluting or roughening. It is thick and hard, and slight ridges mark the annual rings of growth. Pale coloured or bleached white. Common.

THE COMMON PIDDOCK. The elongated shape of this shell suggests that it is a burrowing form. A remarkable tunnel is made in chalk, sandstone or even hard limestone rocks, and becomes a serious menace

to wooden piers under water. The shell is white, thin and brittle, does not completely cover the soft body and would be at the mercy of enemies if a mud dweller. The short, stout foot is covered with sharp crystals of silica (flint) which enable it to act as a file. Persistent rubbing with the tip of the foot gradually wears away the rock until a sufficiently deep tunnel is made. Many chalk rocks in shallow water can be found honeycombed by these holes, and no doubt the piddocks are responsible for much quicker crumbling and weakening than would otherwise take place. As in deep other-burrowing molluscs, the piddock has a long double siphon, which reaches above the entrance of its tunnel into the water.

COMB SHELL or DOG COCKLE. Very like a cockle in shape, but more symmetrical, the shell is finely striated but not fluted. The name comes from regularly arranged tooth-like ridges radiating in rows from the umbo to the edge of the shell.

THE GREAT SCALLOP or CLAM needs no description, as it is familiar in fishmongers' windows. The shell is strong, with a smooth, thick white lining. Fully developed one is about 5 in. across. Frequently acorn barnacles take up a lodging on the shell.

QUEEN or QUIN is a particularly handsome scallop, though not so large as the clam, and sturdier in appearance than the variegated scallop. The figure shews its characteristics.

RAZOR SHELL. An inhabitant of sand or mud, under water, the shell is adapted for burrowing, as well as the curious elongated foot which is capable of

great stretching. It is uncovered only at very low tides. It makes a deep tunnel and moves up and down rapidly by a series of jerks, caused by rapid elongation and then contraction of the foot. The tip of the foot can be puffed out so that it is tightly wedged in the burrow while the shell is pulled down, as well as hooked to grip the ground.

SHIP WORM. This minute shell gives an entirely wrong impression of the creature's size, for it is a mere vestige worn at the tip of the body, which is a foot or more in length and wormlike in shape. It burrows into wood, and is usually found on old wrecks or stranded logs and tree trunks. At one time in the 18th century part of the wooden piles which protect the shores of Holland were seriously attacked by ship worms, causing great alarm. Burrows are made so close together that often only a thin membrane is left between them, and the whole substance collapses. Their attacks were much feared in the days of wooden ships. Woodwork under water is sometimes protected by driving iron nails in very close together as rust soon forms a protective surface layer.

ARK SHELL. Each valve of these strongly built shells is shaped like a roof, on the top of a toy Noah's Ark, having four sides meeting in a ridge. The animals live in shallow water, in holes in the rocks, to which they are attached by tough threads. During life the shell is covered by a ragged-looking dark red skin, fringed roughly round the edge.

SWAN MUSSEL. The largest of the common fresh water shells found in Britain are those of the

two fresh water mussels. Another kind, less frequent, which produces pearls of some value, is found in some of the rivers of Scotland and the north of England. The swan mussel inhabits muddy streams and ponds in which there is some flow of water. It is about 6 in. long, by 2 in. broad, is round at one end and bluntly pointed at the other, from which the two very short siphons protrude. It is greenish-brown, with concentric lines of growth, the umbo being near to the rounded end and close to the hinge. A thick, fleshy foot can be projected from the rounded end (usually sunk in the mud) and by means of this it can shuffle along. In the larval stage the triangular shell valves are clapped together (as in the scallops) to enable it to swim until it comes into contact with a fish. When a long sticky thread hanging down between the shells touches a fish it adheres and contracts. The hooked tips of the shells grip the skin of the fish, and the larva remains feeding till it has changed into a normal, though small, mussel. The tissues of the fish swell up into a blister which embeds and protects the parasite.

PEA SHELL. This is the tiniest of fresh water bivalves, found in most ponds. Frail, pale pink or yellowish in colour, with fine lines of growth. The creature lives in the mud or crawls slowly over vegetation at the bottom.

ORB SHELL. Very similar to the pea shell, but larger, though even this is very small. In fresh water ponds and streams.

38. A Comparison of Two Heads. (*Suitable for introduction to history, Vol. VII., p. 315*). In this picture are

illustrated two typical heads—the one, a Roman head; the other, a barbaric head.

The personalities of these heads appeal to children. Some can sense in the one the keen intellectual power, the scholarly ruling brain, the tremendous force of law and order that formed the idea of the Roman legionary road, straight as a rule, and the ordered power of Rome's disciplined soldiers.

Other children admire equally, according to their own temperament, the freedom and force and grandeur, the untamed barbaric greatness of the other head.

Children readily sense the characteristics of these types among themselves—adventurous, studious, careful and orderly or wild and rebellious.

Caesar's thin lips and stern eye might be cruel and cold, but just. The barbarian's smouldering eyes might flash under his heavy brows, and there might be sullen wrath behind the good nature, but there is fineness in both faces. Some children's love goes to the barbarian, a symbol of grand freedom, savage good cheer and bravery. Other children feel safer with the rather severe Caesar.

Because the English are a mixed race, it is necessary to learn to appreciate national characteristics other than our own.

39. Transport in Roman Times. (*Vol. VII., p. 497*). In the top photograph there is an illustration of the kind of boat probably used by the Romans when they invaded Britain, and also a picture of the type of lorry built for use on their famous roads. Besides the long Roman roads, the invaders also put down square cobbled pavements in many parts of England, and to

this day grass-covered traces of these pavements can still be found. The map provides a local interest if any of the old Roman roads are in the vicinity of the school.

The sketches of pottery, helmet and shoes illustrate the relics which may still be found when excavating on the site of an old Roman camp.

The bottom photograph shows what is left of the huge Roman wall that was built across the north of Britain in order to prevent the Picts and Scots from crossing the border.

40. Costume—Roman British. (*Vol. VII., p. 146*).

The family is typical of the Roman colonists of the period. The lady wears at her waist a neat little housewife's belt with bronze scissors, thimble and knives, and a fine little scarlet leather purse. She has been sewing with a fine, bronze needle. Her leather shoe is neatly punched and sewn; in winter she would wear sturdy leather shoes with strong soles.

The boy's tunic is made of the same cloth as his mother's over-gown. His sandals are of strong leather with straps, such as modern boys wear in the summer (except that the buckles would be of bronze). The scrap of linen bandage round his grazed knee and his catapult are just the same as any small boy of to-day acquires, except for the elastic.

The soldier to whom he is talking is a legionary. Legionaries wore leather and metal harness, the leather parts often cut into strips to stop and entangle a sword. Where metal was used, the strips overlapped and bent like the joints of a centipede; it was a comfortable type of armour, not at all cumbersome. The helmet

(galea) is seen in his right hand; he carries a thick warm cloak over his arm and dangles a key on his finger. In some countries the legionaries wore leather breeches (*braccae*), others seem to have gone bare-kneed with kilt-like tunics.

41. Early Type of Wooden Hall. (*Vol. VII., p. 328*). The characteristic dwelling of the Saxons, Vikings, or any of the peoples living in the Black Forest of Germany or the forests of the north lands.

These wooden halls or castles, built on a plan resembling that of a modern church, were in no way uncomfortable or crude. The roof was supported by strong pillars standing out from the walls, and on these were hung, as shown in the left hand bottom corner, the war gear of the warriors, their cloaks, spears, shields. The space between these pillars developed later into small alcove rooms, varying in number according to the size and grandeur of the hall. Sometimes the rooms were shut off from the main hall, certain of them being granted to the doctor, the minstrel, the retired warrior, in perpetuity—something like pensions. Beds were built into them for special people, as shown in the right hand bottom corner, others would sleep on the rushes in the main hall. The drawings at the bottom of the page, taken from old manuscripts, show three such rooms in use, two for scribes and one for the mother of the family. Other rooms were the chief's room behind the high table, the guard room, store room, women's room, and guest chamber.

A fire, sunk in a trench in the middle of the hall served for heating and cooking but, in addition, there was usually a bakehouse outside.

42. Costume—Saxon Field Workers. (*Vol. VII., p. 156*). The two small pictures below were drawn about 900 years ago to illustrate autumn and winter. In the left hand, or winter picture, the men with axes are felling trees and clearing the ground, and the cart is being loaded with logs of wood. One man is barefoot, and has set his foot in the tree to lop off the top branches before felling. There are two oxen waiting under the tree, with their yokes across their necks, ready when the cart is fully loaded to be harnessed to it to pull it home. The cart is like the old "Scotch carts" still used in parts of South Africa. By it lies a billhook, and over one end is hung the cloak of the overseer or, time-keeper seen in the right hand picture.

In the autumn picture the men are cutting corn. Starting from the left, the first worker grasps a handful of the ears and thrusts in his hook to cut them off. The second has cut his first handful, and is thrusting his open hand into the growing corn to get another grip. The next man is straightening his back while looking over his shoulder to see how they are getting on with loading the cart. The man next to him has put a foot on his sheaf and is tying the bind or knot, and of the last two men, one is carrying a sheaf to the cart, and the other has just flung his sheaf on the load. Corn was not cut close to the ground in those times, but some was left standing, because, good meadow grass being scarce, the beasts could graze on the high stubble.

In the large picture the workers are having their dinner in the field under the shade of the cart. It is late spring, for the marigolds are in flower. They are eating brown bread and young leeks which the woman

has brought in the large rush basket. The cloth round the neck of the man leaning against the cart is a "sowing cloth." He carries it like a bag in front of him when he goes out to sow, full of seed corn which he scatters in handfuls as he walks down the field. He has to walk very slowly and evenly, and throw one handful to each footfall. The sowing cloth made it easy to carry the corn and use both hands at the same time. Both boys wear short tunics pulled up at the waist and open at the sides. The woman has a longer gown which she has rolled up over her knees, for the corner of the field where they sit is damp. The strip of white wrapping under the loaf is a scrap of common cloth woven like linen, probably made of the fibres of nettle or hemp, it would be greyish brown till sun, wind and rain bleached it. The bread is a mixture of grains rather coarsely ground in hand querns, or perhaps at the manor mill. It was baked under a pot buried in hot wood ashes or in a clay or brick oven heated by wood. The red of the cartwheel is probably red earth (iron oxide) rubbed up with grease.

43. Reproduction from the Bayeux Tapestry. (*Vol. VII., p. 498*). A page of actual photographs taken from the original tapestry at Bayeux, a small town in Normandy, France.

The Bayeux tapestry is a band of linen, 231 ft. long and 20 in. wide, now light brown with age, on which were worked with a needle, in a worsted of eight colours, scenes representing the Norman conquest of England. Along the top and bottom of the strip run decorative borders with figures of animals, scenes from Aesop's fables, from farming and hunting and incidents from

the conquest itself. It may interest children to pick out the various figures and say what they are doing.

Each should express his own opinion for although there are some things about which there can be no doubt, others are controversial. Several figures are redrawn clearly in the next class picture, No. 44.

44. Redrawing from the Bayeux Tapestry. (*Vol. VII., p. 499*). Preparations for the invasion. The man at the top left is using a side axe, an unusual type still used to-day in the European forests. It is used to square timber, and he is obviously preparing wood for shipbuilding. Next to this picture two servants are carrying a knight's armour, his coat of mail hung on a pole, which gives some idea of its weight—notice the short sleeves and leggings and the square neck—his sword, scabbard and helmet. Notice the nose piece on the helmet, right corner. The squires wear long-sleeved tunics belted at the waist, hose and cloth or leather shoes. Their clothing is similar to that of the woodchopper, except that his tunic is open at the neck. Middle left is a cart, specially made for the purpose, loaded with spears and helmets. In the centre a man with his tunic kilted up wades through the sea carrying an anchor. Middle right William the Conqueror himself sits on a chair ornamented with animals' heads. He wears a long belted gown, probably of wool, a cloak held by a clasp or brooch, and cloth or leather shoes. The inscription reads "Here William the leader gave orders to build ships." Bottom left shows two huntsmen wading through the sea, evidently carrying the two struggling hounds and the hawk to a ship. The Norman knights must have anticipated good

hunting in England. In the centre a ship is being launched, and on the right a man is enjoying a good meal.

45. Costume—Norman Times. (*Vol. VII., p. 168*). The two small pictures below are taken from an old manuscript. The first shows men's costume, cloaks and tunics, drawn in the smooth curving style admired by artists of the time. In the second small drawing one man is sowing grain, whilst the other is driving two oxen in a plough. The goad reaches their heads, and the animals are guided by switching either side of their faces. The plough is probably a piece of timber cut and trimmed so that the sharp pointed end (perhaps covered with metal to save wear) cuts through the soil, while the flat bottom and sides press the earth aside in an open furrow. The sower wears a short-skirted tunic that reaches to his knees and a soft cap pulled over his head to keep the hair from blowing into his eyes. The second man goes bare legged and barefoot down the soft earth furrow.

These are country people, working on the land and living in huts. In the big picture, the modern artist shows the people who lived in the castle. The man on the left wears a linen shirt under a warm, russet woollen gown, and a loose cloak; it was shaped in a circle and for ceremonies, elaborately embroidered. In this case it is a blanketlike wrap for wear in the draughty hall.

His lady also wears her most homely gown of brown-russet; it is of the warm woollen cloth made from the wool of their own sheep on the estate. She has embroidered her gown in blue and her plain head wrap

of pure fine white linen looks very simple, which it has taken her quite a long time to put on, so as to get the folds adjusted at the most becoming angle. Her long dark hair is bound up with blue silken wrappings, cunningly coiled out at the ends so as to make her long plaits appear even thicker and longer. She is spinning with distaff and spindle as she goes about.

The boy on the right is obviously off for a day in the woods, and has exactly the same plain woollen tunic and cloth hose that any of the men on the estate could wear. His costume is better finished, and his women-folk have given it bands of simple embroidery to strengthen the neck and hem. The cloth for this tunic would be like any modern home-spun woollens and his shoes of tough leather secured by ties of leather or wooden buttons on the outside. His thick brown hair is combed forward; he has a hawk on a strong leather glove on his wrist, and he is brown and tanned for he rides, hunts, swims in the river, eats one large good meal a day (with only bread and cheese if hungry in between meals) and never spends more than an hour over books if he can avoid it.

The dog on the left is a big, grizzly grey wolfhound and is more heavily built (like the old English mastiff) than the later Irish wolfhound. The white dog is rather popular with hunters, for he is seen easily. The hawk is hooded to keep him quiet and the little knob on top is the handle to pull the hood off, so that the bird's feathers are not pulled out by pinching hold of them through the cloth of the hood.

46. The Magna Carta. (*Vol. VII., p. 500*). A photograph of the preliminary chart, or layout of the Magna

Carta. The whole Magna Carta was, of course, a great deal longer. Latin and English versions of the script have been printed underneath in order to help children to understand what is written. The Magna Carta itself is in the British Museum and may be viewed by anyone. In appearance it is a yellowish parchment document and is the original paper accepted by King John.

All the sketches given are copied from actual manuscripts of the period. The kneeling figure on the right is taken from a picture of the murder of Thomas à Beckett, while the figure of the girl tying up the corn was taken from an old manuscript depicting the seasons of the year. The knight in chain mail armour could be recognised by the device on his shield. All knights had their armour specially made for them, so that their individual ideas of comfort and utility gave rise to several small differences of design in the armour of this period. The knight in this picture has the bottom part of his mailed hood loose so that it can be let down to leave his mouth free, or can be hitched up and attached to a series of hooks until it pulled up right across his face.

The man with the scythe wears a straw hat. He is sharpening his tool perhaps with a stone, but more likely with a piece of wood dipped in grease and then in sand.

The beggar on the right wears anything he can find.

47. Plan of Early English Settlement. (*Vol. VII., p. 329*). This plan compares favourably with many villages of to-day. Usually there is still a bridge over the river, a main road through the town, a mill, a manor, castle, or big house, a church, and the farm

fields. Instead of the moot place, there will be the Town Hall; and instead of a big important smithy, there will be a large garage on the main road and a small smithy somewhere in the village.

Villages varied just as much in mediæval times as they do to-day. Probably the greatest difference is that in those days there were no hedges, while all the fields were gathered together, where possible, to form one big space, or common. This land was held in common by all the villagers and being only open level ground, it was usually the scene of any pitched battle. It can easily be understood why it was that war devastated villages. The fields of this common ground were worked in rotation. One part would lie fallow for a year, during which time it would be used as common grazing ground.

Other things shown in the picture are the rush beds, where there would be common rights to cut the rushes, and also open land where the women could wash clothes, and the weavers stretch and shrink their cloth.

Most villagers would fix up a small rest house for travellers or pedlars passing through with their pack-horse train.

In the village shown on the chart, the moot place is near some old Druid stones; it was always in some place well-known to all. The manor was usually strategically placed and well fortified. A frequent cause of complaint was the manor dove-cote for the pigeons would fatten on the common people's fields. The village barn existed before it became one of the many tithe barns remaining to-day.

There was often a little hut built near the bridge for the bridge keeper to live in, while hermits always

lived alone outside the village. Lepers were obliged to live alone by law and they had to live down-stream so that there was no danger of their polluting the water.

48. Costume—13th Century. (*Vol. VII., p. 173*).

The small pictures below were drawn by 13th century artists, usually monks, along the margins of prayer books and histories. Such illuminated manuscripts were often painted in bright colours and enriched with gold and silver. The first drawing on the left is done inside a letter "C," and shows a monk arguing with a knight, while a labourer listens, leaning on his metal shod spade. The monk is tonsured and the knight wears the flat-topped helmet with an eye slit, which was fashionable at that date. The labourer wears the coif—a close linen cap tied under his chin.

The next small manuscript drawing shows cooks preparing dinner. One man is poking the fire under a big iron cauldron, while with the other hand he is about to stir its contents.

(The cauldron was an important piece of property and is shown in many manuscript drawings to indicate a person to be possessed of some means. It was used for cooking food, washing the baby or measuring grain).

The man behind the cook is beating and cutting up meat. Notice the three-legged kitchen table or block and his sensible cleaver.

On the right of this is a man pounding up grain or spices or fruit.

The last drawing shows a man and his dog going shooting (he is re-drawn again above), only at this time as he will be hunting in winter, he wears a cloak and leggings. His bow may be of yew, ash, or any

elastic tough wood, split lengthways, so that half the thickness of the bow is of heart wood, and half outer wood from nearer the bark. The notches at each end are made from sheeps' horns (the sheep at this date had small ridged straight horns). The hollow horn fitted very neatly over the end of the wood and the natural grooves at its tip could be deepened to make a slip notch for the bow string. You carry a bow *unstrung* and bend it to string it taut before you begin to shoot. The arrows are feathered from a white goose wing as they were easier to find.

The labourer (re-drawn in the centre) wears a plain coarse hempen-linen or natural wool tunic. It is just a front and back of one length of cloth with sleeves added and the sides below the waist left open to give more freedom in wear. These side pieces could be wrapped over each other and secured under a belt. This labourer carries coarse fingerless gloves such as hedgers wear to-day and goes barefoot.

The lady's white head wrap is made of two straight lengths of linen—the first is put over her head and around her neck like a scarf. The second piece is sewn into a ring and pulled on like a crown, holding the first piece steady. She wears a bluish-grey woollen gown, over a linen gown (smooth) below. The linen shows at her wrists, and would show at her ankles if she lifted her skirts. She has a woollen wrap or cloak made from the natural dark brown wool of the mountain sheep and her shoes are plain, soft strong leather. We cannot be quite sure about her little hen, but it was probably just ordinary barn-door brown, and rather short in the leg, as some of the old Scotch breeds called "Dum-pies" used to be.

49. Plan of a monastery. (*Vol. VII., p. 326*). The particular abbey illustrated is in North Wales, and was inhabited by Cistercian monks, who specialised in sheep farming. It was built in 1200 when the owner of the castle seen to the east in the map gave the monks the small shut-off valley near his land. The monks, who came over from France, built a church which they dedicated to the Virgin Mary, and founded an abbey which in time became very rich. It was called the abbey of the Vale of the Cross, apparently from the crosses put up by the monks along the mountain tracks which led to the abbey. These crosses served as guides to the herdsmen who came from a distance bringing wool on pack ponies. One such cross is shown in the bottom side picture, with a cleft stick at its side in which is a scrap of parchment, a message for a passing monk or drover.

The stone for building was quarried by the monks, and the old grass-worn tracks where they slid down the boulders are still there. A small stream well stocked with trout went by the abbey, and the monks made a fishpond in addition, with sluices. A spring in the abbey garden was led underground into a proper drain, so that there was plenty of water for the kitchens, and for baths, whilst the refuse drain went into the river below the abbey.

The general layout of the church, chapels and cloisters is shown, and other points of interest are marked in the plan. Notice the strategic position of the abbey. All traffic down from the hills must pass it, far enough away not to trouble the monks, but close enough for convenience. The main roads, north and south, led to the wool markets, and the tracks over the hills were

in all directions to enable the monks to gather the wool.

Of the two remaining side drawings, that at the top shows the abbey as it is to-day, while below it a young monk is marking one of the new lambs with the abbey mark, probably using red raddle as they do to-day.

50. A Miracle Play. (*Vol. VII., p. 345*). An illustration showing how a small community would make a little show with an ordinary farm cart. The whole thing could be pulled through the village to a suitable place and the little play acted on the cart.

Mediaeval people liked very dramatic effects and there are instructions how to make saints rise from the dead by means of pulleys with half a dozen men hauling on the ropes, and how sheep's wool could be teased out to look like clouds for the angels to sit on. This illustration is a simple reconstruction in which two angels wearing the ordinary dress of the period stand against a rail to which their painted wooden wings are nailed, the joints being hidden by their flowing head-dresses with boughs of fresh green leaves covering the barrier. They are holding in check the personified evils of greed and jealousy, made up with cow's horns, etc.

The cart is decorated, and there are cow bells and sheep bells hung on it to clatter as it moves along. Beside it the artist has drawn a local saint with his jailer, who is wearing any old armour or "wild looking" clothes he can get hold of. The blacksmith has made a spear which pierces right through the saint, and horrifies the mediaeval people although they know it is made in a circle that goes round his body. To appear more

realistic he has been well bedabbled with sheep's blood and the jailer has been told to "use the ox-waggon chains" and to "look fierce."

51. Costume—15th Century. (*Vol. VII., p. 185*). During the 15th century, dress became extravagant. The simple country people did not wear extraordinary clothes, but about the court fashions came and went so fast that it was difficult to keep up with them. To give a general idea of ordinary street usage, the manuscript picture on the left is taken from an execution scene described in a volume of Froissart.

There are some important people on horse-back with pages standing behind them, holding their horses' tails (at least they should be, but one small boy is stealing apples from the open basket of the market woman standing next to him). A young man dressed in the extreme of fashion with gold curls and long pointed-toed shoes (most unsuitable for horseback) edges close to some comfortably dressed townsfolk.

Above has been redrawn a young dandy at the time of Richard III when it was fashionable to wear a loose brocaded jerkin and carry your hat on your walking cane. His gloves are embroidered and scented, and though his hat in this case is black, it could have been pink plush or pale blue. No wonder the market woman is struck dumb at his style. The only detail that needs explaining about the woman's costume is the hood which has a long tail or liripipe, so long that she tucks the end of it into her girdle.

52. 14th Century Castle. (*Vol. VII., p. 501*). This illustration, taken from a French manuscript of the

period, shows the rich comfort, the solid elegance, of the 14th century castle. The floor is covered with a carpet of rushes plaited and then sewn together as a carpet.

The bed, made of oak, is beautifully carved and painted; the mattress is of feathers over carded wool, the sheets of real linen, and there are warm blankets and coverlets. Heavy hangings round the bed keep it warm and snug in the draughty, stone room. In this picture they are hung from the ceiling and walls surrounding the bed after the French fashion, English people preferring hangings on the bed itself.

The cradle is probably made of wood and wicker or rushes mixed. The twin who is waiting for his shirt of "fair white linen, as usen babies all" is nursed by a lady wearing a rich velvet gown with fur trimmings and gold embroidery. The woman who is airing the child's garment by the log fire has detachable sleeves to her gown. Notice how the wood of the fire is placed, the logs laid star-wise so that they can be pushed inwards and kept burning all night.

The metal basin and water jug near the kneeling woman are kept polished brightly with sand, wood ash, rushes and a little oil. The narrow stone windows, lined with wood, are fixed with covers of silk, pieces of horn or buttered paper, to let in the light and keep out the wind. Old castles still show the heavy stone mantelpiece built into the fabric.

Under the main picture is a group of people copied from manuscripts of the period. The brewer, who has just made some liquor from honey, barley and herbs is holding it up to see that it is clear. In his belt he carries an iron for tapping the barrels. The maid is

carrying hot water for the baths; she wears a plain woollen dress and a linen apron, and her hair is turned up on account of the steam from the boilers. Holding back a curtain so that the marshal may pass is a page. The former manages the household and estate during the absence of the Lord of the castle.

Different kinds of bread are demanded from the baker—flat dinner rolls that could be used as plates, fine manchet bread, and coarse bread of mixed grain for the common folk.

The rush cutter is responsible for keeping up the supply of cut rushes, and in winter plaits the rush matting.

There are many other people employed in such a Castle but these few types give an idea of the comfort then desired by the ruling classes.

53. Development of Shipping in Tudor Times. (*Vol. VII., p. 382*). Various craft, from the large top-heavy ship to the small rowing boat. The following points may be noted:

1. The way the shields of the royal lords are hung alongside. These should be compared with the way the Vikings hung their shields for storage and additional protection against the seas.

2. The covers for the guns. When they were fired from the stern, the recoil sent the ship forward.

3. The towers with cannon.

4. The royal coat of arms on the middle ship, the last sail of which is being hoisted.

5. The companion ladder up which the royal passenger mounts and the sailors who steady the ladder.

6. The men gathering earth for the guns.

7. The costumes.

Below is a very valuable manuscript drawing of the Elizabethan shipbuilder at work on careful plans and charts. Notice the improvement in speed lines between the ornate battleships of the top picture and the small *Santa Maria* in which Columbus sailed to America.

54. Costume. Elizabethan Period. (*Vol. VII.*, p. 201).

The bottom pictures on the right is of the time of Henry VIII and shows fine lords and ladies going on a river picnic in a barge decked with green boughs and flowers. The next small circle picture taken from a calendar (the sign of the scorpion in the sky), shows a countryman carrying a sack of grain on his back. His clothes are much the same as in previous centuries, but of better quality, and he now wears a linen smock or tunic to protect them. The next picture is of a well-to-do woman riding to market. Her hat is of black felt, and her starched ruff and stuff dress are much finer than those of previous centuries. The stout woman with the geese and hens is probably quite as well off, but doesn't "hold with" these new fashions, and continues to wear the old-fashioned head wrap of her grandmother's time.

In the large picture the same two women are seen at market. The central figure might well be Welsh, for the Welsh national costume dates from this period. The small white cap under her tall hat is becomingly frilled. Her sleeves would probably be made separately and tied or stitched to the fitted bodice she wears over her corset. This makes the dress more easy to sew, and the sleeves slip off quickly when there is rough work to be done. Her ruff and cuffs crackle with starch, for

starch is a new invention and she likes to be up to date. Her thick white stockings are probably knitted wool. Her shoes are stout black leather and have heels an inch high (another innovation in this century). The more old-fashioned woman behind her has only an extra strip of leather on her strong boot heels. Her bodice is cut to show the sleeves of the old-fashioned chemise which women have always worn.

The man's costume, taken from another manuscript, was probably copied by a country tailor from a city man's clothes. The tailor probably used ordinary country home-woven cloth, though he may have chosen one of the new dyes which the Elizabethan sailors were always on the look out to find. Courtiers' collars might be of fine lace, copied from Italian, Dutch or French fashions, but this man's is of English lawn and fine but simple English needlework. His felt hat has a gallant plume, his stout country shoes a cheerful trimming, and his beard and hair are cut as close to the court fashions as he can copy, for he admires Sir Walter Raleigh, and the other sea captains under whom he has sailed. Meanwhile he shows the ladies his latest trophy, a flying fish brought back from his travels.

55. The Elizabethan Stage. (*Vol. VII., p. 346*). This picture may be conveniently studied with Class Picture No. 50, the Miracle Play. Carts and wagons were still used as impromptu stages, for the actors were strolling players, and used the yard of an inn as their theatre. The convenient balconies account for the number of balcony scenes in the plays of the period. These balconies, and the absence of elaborate stage scenery, made it possible for an author to have as many

short curtain scenes as he wished. The lower right hand picture shows how the inn yard came to be adapted as a stage by the use of screens or curtains, and the top right hand picture shows the stage in use, an actor speaking his lines, a prompter behind him, probably concealed behind a screen, the musicians in the gallery and the audience in front. In the attic, which in our modern theatre has become the "flies," is an assistant who later became responsible for scenery, lighting and all the other impedimenta of modern stagecraft.

The bottom left hand picture shows the old "Globe" theatre, Bankside, on the bank of the river Thames. Built about 1695, it was one of the earliest English theatres. These were built very much like the old inn yards, with three galleries round the sides, rooms, corresponding to our "boxes," underneath them, and the main part of the theatre open to the air, without seating accommodation. It was in these primitive theatres that the plays of the great Elizabethan dramatists were first acted.

56. Costume—Cavalier and Puritan. (*Vol. VII., p. 207*). The fashions adopted by the Cavaliers and Puritans ran parallel. Each side had its degrees of wealth or severity, the difference in appearance varying according to the outlook.

The Puritan woman wears under her gown a linen chemise and petticoat, perhaps a corset or fitted bodice, and home-knitted hose gartered below the knee. Her gown, made of wool in winter and linen in summer, is, save for its fine stitching, quite untrimmed. Her man wears the old style black felt hat, its band and small buckle being not for trimming but to draw it

tighter to the head. His white collar and cuffs (or the white linen neck and wrist bands), are to keep the black stuff from rubbing his neck. The plain buttons would be bone, horn or wood. The breeches are close-fitting and gartered at the knee. A strong leather belt, knitted hose and plain, strong shoes complete a comfortable and effective costume. The shoe buckles were of real use, serving to pull the strap holding the shoe firmly to the foot. His short straight hair was a great contrast to the ringlets of the Cavalier, and probably much easier to keep clean.

The woman on the right has been dressed especially simply to show how fundamentally alike in cut her costume is to that of the Puritan. The bodice fits the figure and the basque or lower portion hangs over the reasonably full skirt. There is a lace or soft lawn collar, and her sleeves are beribboned and laced but the pattern is obviously the same in essentials. Her small child's frock is not the over-elaborate monstrosity in which many of the Royalist children have been painted, but the ordinary small girl's frock in which hundreds of 17th century mothers dressed their children. The silky toy dog on the right is a King Charles spaniel, an expensive whim of the period. The good Puritan cat wears a plain black coat like her master, and keeps it well polished. They are both quiet self-contained people.

The small pictures below show Dutch influence, and date from halfway through the 17th century.

57. The Great Fire of London. (*Vol. VII., p. 502*). Old print showing fire, with below, sketches of people of the period. The print shows clearly the size and position of the fire—Whitehall is on the left and the

Tower and Tower Bridge are on the right. Note how the engraver depicts the fire confined to one fairly circular district; the direction of the wind; the spelling of notable places. The last point is due to the fact that the fire was of great interest overseas, and many prints of it were made by engravers in the Netherlands.

The first figure in the lower drawing is playing a viol, an instrument distinguishable from the violincello, which has now superseded it, by its rounded shoulders and six or seven strings. The next couple are discussing the game of "pallo," from an Italian word meaning "large ball," a game played with an inflated ball covered with leather, the immediate forerunner of our modern football. It should not be confused with Paille-maille (note the connection with Pall Mall), a French game combining croquet and golf, that was very popular in this period. Tennis as distinct from lawn tennis was played in a walled court, the oldest one now extant being at Hampton Court and dating from 1530. The racket shown in the picture was an Italian development to take the place of the hand in service. Between the 17th and 18th centuries the game began to decline in favour rapidly.

58. Costume.—18th Century. (*Vol. VII., p. 213*). An ordinary small market town of the period. In the inn doorway stands the fat, comfortable innkeeper. Notice his inn, typical of the building of the period, plain and square, with a handsome doorway, fanlight and large windows, so that the rooms would be light and airy. He must be a man of substance to own such a large inn which is evidently a place of call for the post-chaises and other traffic passing his door. On the left

of the picture are two people who appear to be waiting for the coach. The lady wears a travelling bonnet and a shoulder wrap, and the man, riding boots and a top hat. When travelling he rides on horseback a little ahead to avoid the dust, the lady being inside the coach. More to the centre of the picture are people, who by their light outdoor costume probably live in the town. The children in the second group have a "nursery" dog to play with. Behind the man escorting the ladies, one on each arm, are two menfolk riding in from the country; they probably live in a large country house five or six miles out of town, and will have lunch at the inn before returning. A fine team of horses is hauling a great timber drag through the streets. English timber fetched a good price at this period and many avenues now seen around country houses date from this time.

Of the central figures in the picture the woman with the basket on her head and her old mother beside her with their dog have obviously just walked in from a country farm. The old woman goes barefoot, for the grass over the fields is smooth and green, but the younger woman has strong sensible shoes which are more comfortable on the cobbles of the town. They both wear thick, woollen, handwoven skirts, and long loose blouse-like tops that hang over the skirt and are loosely belted at the waist. These are of strong natural linen, but the handkerchiefs around their necks, as large as small shawls, have bright colours. The sheep-dog, exactly the same breed that minds our sheep to-day, keeps very close to the two womenfolk for with him they feel safer on the lonely country roads.

The basket of strong wicker work which the woman carries is woven of osier which grows by the brook running through their farm. There are many things which they may be bringing in to sell—fresh vegetables, plump cockerels, eggs, butter or small cream cheeses.

On the right hand side is an interesting little group. The old countrywoman selling apples obviously knows the lady in white who is talking to her. The market woman looks very comfortable in her thick dark cloak; she wears the old-fashioned white frilly cap, tight over her ears that her grandmother wore in Queen Elizabeth's days. There is a great pile of empty baskets beside her, more than she could possibly have carried in on foot, so she is probably a farmer's wife who has driven to town in a comfortable farmer's cart, and is selling her apples and meeting old friends while her menfolk are doing their business in the town. Perhaps at one time, when she was young, she was a servant girl to the woman in white, and left her to be married and to live on her husband's farm.

59. 19th Century People and Things. (*Vol. VII., p. 221*). The top group of pictures is typical of a good middle-class family of the period. The first shows the link with the 18th Century and the others betray the strictness imposed upon the Victorian family. Even the tree enclosed in its railings is expressive of the lack of coddling, the plainness of diet and the rigidity of study of the young people. On the next line is a chimney sweep and his boy. At that period the wide chimneys were swept by boys who climbed up inside, and many old chimneys still have manholes where the boy stood to wield his broom. The next drawing shows the cook

before the fire, which burns in a range, for since the general use of coal fuel the open fire was used only in country places. The cook is basting the joint which turns on a spit now worked mechanically. The kettle hangs on a hook over the fire in the old-fashioned way. Beside the fire is an iron pot, known as a "digester," into which was put bones or pieces of meat to be made into stock; cooking in those days was lavish but not wasteful. At the side of the fire, below, is a tap which draws water from a side boiler for washing up and household use. These boilers were the beginning of our modern hot water system. The housemaid, like the cook, wears a print dress with a white apron and cap, though dress, apron and cap are of a different cut. She wears a rough apron over the white one, for she is going upstairs with her broom, feather dusters and housemaid's box of polishing cloths to clean the rooms.

Next to her is the laundry maid. Most houses had a special laundry attached, for washing was done at home till quite late in the century. Full skirts, curtains and draperies, linen underwear and lavish bed linen made the wash very heavy. Besides soap, the Victorian laundresses used special preparations of lye, a washing mixture which they made themselves out of strange ingredients such as herbs and fowl dung. As shown in the picture, the irons were heated in rows on a little coal stove.

The first picture on the next line shows two children working in a factory. The conditions of factory life in those days were appalling. The children were paid miserable wages or none at all if they were orphans, and worked for very long hours. Sometimes nails were put through the benches beside the machines they

tended so that they could not sit down and fall asleep. Children who worked under these conditions became wretched little creatures, old before their time. Contrast with their life the healthy existence shown in the next picture of country people at work. They had plenty of good home-made bread and dripping, as much milk as they could drink and even the poorest were able to keep pigs to provide their own bacon.

The bottom pictures show domestic articles characteristic of the period. The hip bath, saucer bath and hot water jug belong to a time when it was usual for all water to be carried upstairs. Next come four methods of lighting before the days of electric light—the oil lamp, candle, gas jet and tallow dip—this last in use in the country. Next are two churns, the recently introduced box churn, and beside it the old plunge churn commonly used. The milk was poured into the shallow cream pans, seen beside the churn, and left till the cream could be skimmed by hand. The skimmed milk could be obtained for the asking, and was much richer than its modern equivalent left behind by the separator. Last comes a little wooden cradle on rockers.

80. Development of Transport. (*Vol. VII., p. 503*). *From mediæval times to the 19th century.* In the bottom left-hand photograph there is an illustration of the curious long boat—a compromise between the Viking Long Serpent and the mediæval tub (see Class Picture No. 61). The pack horses are typical and became one of the most useful and common means of transport for many years. Some of the animals have wool sacks on their backs; the original size and weight of the wool sack depended on the fact that it had to

be carried by pack horses. In the corner of the photograph is a heap of ingots of lead from Cornish mines, stamped by law as being of a weight suitable for mule transport. On the right, transport is seen as in Tudor times. The ship is longer and speedier than in mediaeval days and the covered wagon used for transport shows another considerable step forward. Note that pack horses were still in use. The large photograph shows the great progress reached by the 19th century. There is the stage coach, with the accompanying development of trade routes, and the post houses where the coaches would stop to deliver the mail. (This name still remains in the modern *Post Office*.) Note the introduction of steam in the form of the railway and train, the steam coach and the steamer at sea. The air as a means of transport was beginning to be exploited, and there were balloons and air ships occasionally to be seen. Near the signpost, a man is riding a velocipede, the precursor of the bicycle. The spotted Dalmatian dog, exceedingly popular at that date, is another interesting object.

61. Development of Ships. (*Vol. VII., p. 388*). The development of ships through many centuries. There are illustrated the characteristic Viking ship or Long Serpent; the rounded, slower mediaeval ship of the time of the Crusades, which developed in length through the Tudor period (see Class Picture No. 53) to the more speedy Armada ships with a holding capacity fitted for the new world trade. During a later period, when competition made speed all important, there came the race of the tea clippers for the eastern trade.

62. Famous Musicians. (*Vol. VI., p. 215*).

PURCELL. 1659-1695. Purcell, the first great English composer, was fortunate in being allowed to study music from an early age. As a boy he was admitted as a chorister in the Chapel Royal where he frequently sang before the king. Later he was appointed organist at Westminster Abbey, where he played at two coronations and one royal funeral service. Purcell's genius has been underrated by the fact that Handel came to England shortly after Purcell's death and made such an impression with his music that the latter was overshadowed. Purcell died at the age of 37, before his gifts had been developed to the full.

J. S. BACH. 1685-1750. John Sebastian Bach, a German, came of a very musical family. He was given every opportunity to develop his gifts and obtained his first important post at Weimar in 1708, where he became famous as an organist. The most important period in his life was from 1723 until his death in 1750 when he occupied the post of director of music at St. Thomas' Church, Leipzig, becoming very famous as a performer and teacher of music. It was during this period that he composed his great cantatas, the *Passion* music and the *B minor Mass*, often said to be the finest music ever written. Towards the end of his life he suffered the terrible affliction of blindness; and it was not until 100 years after his death that his work was fully appreciated. He is now considered to be one of the greatest composers of all time.

HANDEL. 1685-1759. George Frederick Handel was another of the great German composers. His father, a keen business man, was antagonistic towards

music as a career, but the boy managed to go to Berlin to study. In 1703, Handel went to Hamburg as violinist in the orchestra at the Opera House. Here his first opera was produced. He then went to Italy for further study and in 1710 went to London where he wrote the famous *Water Music*. He wrote many operas in London but owing to the duplicity of rivals he became bankrupt and was forced to sell his opera house. He then devoted himself to the composing of the oratorios for which he is now remembered. The greatest and most popular of his works is the *Messiah*. He, like Bach, was overcome by blindness and died in 1759. He was buried in Westminster Abbey.

HAYDN. 1732-1809. Franz Joseph Haydn was an Austrian. His family life was extremely happy and he was given every encouragement in his musical studies. He went to Vienna to join the choir of St. Stephen's Church, but was dismissed because of the practical jokes he played on other members. He was then engaged as conductor of the private orchestra of a rich noble and soon became recognised all over Europe. He visited England in 1790 where he was given a great welcome, and was accorded the degree of Doctor of Music as a token of admiration and regard. One of his greatest compositions is the choral work, *Creation*.

MOZART. 1756-1791. Wolfgang Amadeus Mozart was also born in Austria. He began to compose as a child and he and his sister toured Europe with extraordinary success. In London everyone was charmed with the children's genius. Later Mozart went to Italy for further study and then obtained an unfortunate

post with an Archbishop. His wife spent unwisely the little money he had and unable to obtain a suitable post he became exceedingly unhappy and discouraged. He died in 1791, and his body was laid in a common pauper's grave, unattended, during a raging storm. Mozart's life was very hard: after his brilliant success as a child he had to suffer poverty, harsh treatment from the Archbishop and much misery during the greater part of his life. Nevertheless, his music has lived and no one to-day disputes his genius.

BEETHOVEN. 1770-1827. Ludwig van Beethoven, German by birth, began to study music at an early age and soon became assistant music director in the Chapel of the Elector. He had lessons from Mozart and later from Haydn, and rapidly became famed. In character he was extremely temperamental, his sole thought was for his beloved music and he was the most thorough and careful of all composers. He spent his life chiefly in Vienna, though his *Pastoral Symphony* shows that he loved country life. Beethoven's life was overshadowed by tragedy for, as quite a young man he had serious trouble with hearing and this later developed into complete deafness, one of the bitterest sorrows any musician could have to face. He died in 1827, deeply mourned, and to-day is loved and honoured as perhaps the greatest of the music masters.

SCHUBERT. 1797-1828. Franz Schubert was born in Vienna at a time when this city was the most important musical centre of Europe. He went to a school to train for the choir of the court chapel. On leaving he taught for a little in his father's school, but soon

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began to write the songs for which he is now famous. He had an amazing faculty for spontaneously setting poems to music; he was not a careful composer like Beethoven but wrote whatever came into his head. He was extremely shy by nature. He died at the age of 31; yet in spite of his short life, made such an impression on the musical world that he is sometimes called the father of modern song.

MENDELSSOHN. 1809-1847. This composer was born in 1809 in Hamburg. The son of a wealthy banker he was able to enjoy a happy life both socially and with his music, for his facile compositions were immensely popular during his life. He travelled a great deal, conducting concerts and meeting many famous musicians. He aroused public interest in the works of J. S. Bach, who was then little appreciated, by arranging a public performance of the *St. Matthew Passion*, with the result that Bach's genius was at last recognised 80 years after his death. Mendelssohn was an excellent organist and gave many recitals in famous churches and cathedrals. He also composed many choral works, including *St. Paul*, *Hymn of Praise*, and *Elijah*. His overture to *A Midsummer Night's Dream* is known and loved universally. He died at the early age of 38, greatly mourned by those amongst whom he had been so popular.

CHOPIN. 1810-1849. Although Frédéric Chopin was born at Warsaw he had many French characteristics, since he spent the greater part of his life in France. He studied music when young and became famous as a child pianist. He toured Europe and in 1837 visited

England but for health reasons was compelled to leave for the Mediterranean. In 1848, Chopin fled from France to London on account of a revolution. He gave many concerts, but his rapidly declining strength could not stand the strain. He returned to France and died there the following year. Chopin's finest music was written for the instrument he played so well—the pianoforte. He is often called the "Poet of the Pianoforte," for no other composer has written such exquisite music for this instrument.

WAGNER. 1813-1883. Richard Wagner was born in Leipzig, a famous centre of music. He came early under the influence of the theatre and the knowledge gained served him in good stead when he came to write his operas. He went to Paris but, unappreciated, he was forced to live in great poverty, so he returned to Germany, where, at Dresden, he met with a small amount of success. He was, however, exiled from Germany for some years for holding revolutionary ideas, during which time he visited various parts of Europe. On returning later he lived in Munich, afterwards building a theatre at Bayreuth in which his musical dramas were performed. His life was one of hardship and suffering: he had money troubles; people were not attracted by his great works; and he was not a popular figure owing to his brusque manner. Now, however, his operas—*Lohengrin*, *The Ring*, *Tristan and Isolde*, *Parsifal*, *The Flying Dutchman*, with their exciting, eventful music are greatly appreciated.

BRAHMS. 1833-1897. Johannes Brahms was another composer from a musical family. He was

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encouraged in his early musical studies and when about 20 years old went on a tour, during which he met many famous men, who helped him in his career. His work was not at first appreciated, but Schumann's wife, Clara, who was a world-famous pianist, did much to increase the popularity of his compositions. Brahms gained a great reputation as a song writer, having come under the influence of Schubert; he also wrote a number of choral works, the finest of which is the *Requiem*. He led a full, hard-working life and was greatly interested in sport.

ELGAR. 1857-1934. Edward Elgar was born in Worcester in 1857 and was the greatest English musician after Purcell. His father was an organist, so the son was encouraged to develop his musical talents. Though a brilliant performer on many instruments and a prolific writer during his young days, Elgar did not gain public appreciation until 1899 when he wrote the *Enigma Variations*. Several years later, he produced his great oratorio, the *Dream of Gerontius*. The famous tune, *Land of Hope and Glory* was also one of his compositions. He was the first great English composer of symphonies, and during his lifetime received many decorations as a tribute to his genius.

63. Poets—1. (*Vol. I., p. 342*).

WILLIAM SHAKESPEARE. 1564-1616. The great poet and dramatist of all time. Born at Stratford-on-Avon, educated at the local Grammar School, he left the town after his marriage to Anne Hathaway in 1582 for London where he became actor and playwright. As a member of the Lord Chamberlain's

Company of Actors, later known in the reign of James I as His Majesty's Players, he wrote and revised many plays. At the Mermaid Tavern, Cheapside, the haunt of many notable writers and wits, he met Ben Jonson.

"What things have we seen

Done at the Mermaid? heard words that have been
So nimble and so full of subtle flame,

As if that every one from whom they came

Had meant to put his whole wit in a jest. . . ."

Francis Beaumont.

Shakespeare's early plays, *A Midsummer Night's Dream*, *Henry IV* and *Henry V*, met with great success and by 1599 he had become part owner of the Globe theatre and then later, the Blackfriars. In the same year he began his great comedies, *Much Ado About Nothing*, *As You Like It* and *Twelfth Night*, to be followed by *Julius Caesar*. On the accession of James I his prosperity increased, and, resulting from his maturing years and also from the general tendency of the times, came the noble tragedies of *Othello*, *Macbeth*, *King Lear*, *Antony and Cleopatra* and *Coriolanus*. His dramatic activity culminated in *Cymbeline*, *The Winter's Tale* and *The Tempest*, and in 1611 he retired, going back to Stratford, to his country house, New Place, bought many years previously.

On his death he was buried before the altar in Stratford Church, a modest memorial to literary gifts that were monumental in their beauty, grandeur and catholicity of thought. Jonson thought that Westminster Abbey should have been his resting place and wrote:

"Thou art a monument without a tomb,
 Thou art still alive still while thy book doth live,
 And we have wits to read and praise to give."

To-day, the Shakespeare Memorial Theatre, built at Stratford by world-wide public subscription and opened in 1932 by H.R.H. the Prince of Wales, and also the continuous stream of visitors to his birthplace, give testimony to the greatest of all dramatists.

HERRICK, ROBERT. 1591-1634. English poet, was born in Cheapside, London. He was educated at Westminster School and after serving an apprenticeship to his uncle, a goldsmith, went to Cambridge in 1614. Here he met many young men who became his friends; Ben Jonson took him under his care, calling him his poetical "son." The next ten years were spent in preparing to take holy orders at Cambridge, with occasional visits to London, and in 1629 he was sent to the vicarage of Dean Prior in Devonshire. He lived here, surrounded by his many domestic pets, loving the country and the quaint customs that still survived in the little remote village.

He had a gentle disposition and was greatly loved by his parishioners. During the Civil War he was a loyal supporter of Charles I and consequently lost his living when Cromwell came into power. He went to London and lived in poverty until, in 1662, he returned to Dean Prior where he remained until his death.

Herrick's poems are short and the majority exquisite. He has a simplicity and a gentleness that lends itself to expression in the tiny, charming lyrics for which he is famous. He immortalised the rural traditions of

Dean Prior while he painted word pictures of homely English life that have never been excelled.

Among his 1,300 lyrics the following are quoted most frequently and perhaps give the best idea of Herrick's genius:

The Night-piece ; To Julia ; Corinna's going a-maying ; To the Virgins, to make much of Time ; To Daffodils ; The Poetry of Dress ; To Anthea ; To Blossoms ; Litany to the Holy Spirit.

BLAKE, WILLIAM. 1757-1827. English poet, was born into a poor home in London. At a very early age he showed signs of artistic ability and his father gave him every opportunity of developing his talent. He served an apprenticeship to Basire the famous engraver and at twenty-one years of age set out to earn his living as a professional engraver.

In 1787 he began experimenting with a new kind of printing, and his famous *Songs of Innocence* were printed later by this method. He found a great friend in one, Captain Butts, and his support enabled Blake to continue with his mystical works.

During the years 1789 to 1795 his output as a poet was very great. Much of the poetry was of that pure lyrical beauty which gives Blake a unique position as a poet, but later on this simplicity became overwhelmed by the numerous visions he had, and he concentrated on developing his mystical and metaphysical theories which have proved so confusing to many of his readers.

During all this time he never ceased painting and many of his pictures are now in the Tate Gallery. His greatest artistic work, the illustrations for the *Book of Job*, was done in the year 1821. In 1827 he died

while working on illustrations for Dante's *Divine Comedy*.

Blake lived necessarily inside himself and he influenced his contemporaries very little. His paintings are of a most original type, being of a deep and penetrating visionary power, every figure having some mystical meaning. Much of his thought is quite incomprehensible to present-day students, for his solitude of mind and the advanced stage of mystical insight which he attained are in some cases too obscure for analysis. Yet in spite of this he wrote poems of such simplicity that he has been given the name of "the children's poet." He was in no way sophisticated but believed that the imaginative and the spiritual side of man's nature should be nurtured and exalted.

The following poems are well known:—*The Tiger; Songs of Innocence; Infant Joy; Land of Dreams; Jerusalem*.

BURNS, ROBERT. 1759-1796. The greatest of Scottish poets, was born near Ayr. During his boyhood he worked as a farm labourer, reading and studying whenever he had a moment to spare. He was never robust but nevertheless continued studying, poring over books of poems in his cold bedroom at night and eating with a book of verse propped up by his plate. In 1781 he began to learn the trade of a flax dresser but the shop was burned down, leaving Burns penniless. He returned to farm work for a period, but continued writing poems which he felt sure would bring him fame. In 1786, on the success of his first volume of poems, he went to Edinburgh where his fiery imagination and his eager flow of eloquence made him a popular and

amusing companion. A few years later, having been cheated in connection with a contract to write some poetry, he retired loftily from public life. The last of his years were unhappy—he adopted violently revolutionary political views, and was exiled from society. He still remained popular with the peasants, amongst whom he found his best friends, and when he died he was buried with local honours.

The charm of Burns' verse lies in his ardent and sincere nationalism. He loved the country, and having spent most of his life working on the land he knew and understood country ways and country people. Nature was his great friend, and being somewhat of a moralist he frequently drew lessons from nature which he felt should be taken to heart by all human beings, for, he thought, they are just as helpless and weak as the "tim'rous beastie," the field mouse.

Although Burns was so intensely nationalistic in character, his outlook and his sympathies were by no means narrow. Burns restored to poetry the sincerity which had been absent almost entirely since the time of the Restoration. It is the depth of feeling, the vividness of description, and the burning patriotism, which make his poems so justly famous.

The following are among his notable works:—*Hallow-e'en; Tam o' Shanter; Jolly Beggars; To a Mouse; Highland Mary; Auld Lang Syne; Man Was Made to Mourn; The Two Dogs; Mary in Heaven; Ye Banks and Braes o' Bonnie Doon; O My Luve's like a Red, Red Rose.*

WORDSWORTH, WILLIAM. 1770-1850. English poet, was born at Cockermouth, Cumberland. After attending the Grammar School of Hawkstead, he went

to St. John's College, Cambridge, where he spent most of his time reading classics and Italian poetry, and also continuing with the writing of poetry begun as a boy.

While in France to study the language he became a strong supporter of the republicans in the French revolution. He was also greatly influenced by Godwin, a revolutionary thinker of the time, through him developing a belief in the right of individual reason as opposed to collective reason. In 1795, however, he was left £900 and he and his sister Dorothy bought a cottage at Crewkerne where they lived for four years. Here, Wordsworth met Coleridge and with him planned the *Lyrical Ballads*, at the same time freeing himself of the revolutionary outlook that had so exercised his mind.

The *Lyrical Ballads* appeared at a time when poetry was shackled by convention and hampered by too much reasoning and too much rationalism—when Napoleon was terrifying Europe—and they restored the purity of poetry of the senses. Poetry and reasoning cannot be associated and these two poets set out to portray beauty as realised through the senses; Wordsworth, by showing the poetry in ordinary everyday things, and Coleridge by showing the poetry in supernatural things. Wordsworth illustrated the unusual meaning hidden behind common objects; and Coleridge showed the comprehensible side of the supernatural.

After the publication of these poems, Wordsworth went to Germany, but in 1799 he settled in Grasmere where he spent the remainder of his life.

The poet now began to write *The Prelude*, a chronicle of his development since childhood. It is a poem of great imaginative power and is a further step towards the

romantic revival begun with the *Lyrical Ballads*. In 1807 he published another volume of poems and this, together with his earlier publications, established him as a master of poetical form and style. The death of his brother during this time affected him very deeply, increasing the melancholy in his nature until it finally developed into a decline of poetical ability and power, although now and again he wrote poems of first-class quality.

In 1839 Wordsworth received an honorary degree from Oxford University, and five years later he was appointed poet laureate. In 1843 he died and was buried at Grasmere in the little churchyard.

Wordsworth, by his gentle understanding of people through his study of nature, has become one of the best-loved poets. He is simple and sincere and, living happily in Grasmere surrounded by ordinary humble people, he looked for what he felt to be the truth regarding the great communion between nature and man. To him there was a spirit in every blade of grass, mountain, and river, and this spirit could be communicated so that nature and man became one in sympathy and life.

The following poems should be noted:—*The Prelude*; *The Recluse*; *Excursion*; *Ode on Intimations of Immortality*; *The Fountain*; *Two April Mornings*; *The "Lucy" Poems*; *The Ruined Cottage*; *The Daffodils*; *The Reaper*; *Poet's Epitaph*; *Descriptive Sketches*; and many sonnets of perfect beauty.

COLERIDGE, SAMUEL TAYLOR. 1772-1834. English poet, was born at his father's vicarage of Ottery St. Mary, Devonshire. As a boy he went to

Christ's Hospital, where he studied for eight years. He then went to Cambridge, but he soon grew discontented with university life and in 1793 went to London. He was extremely poor and enlisted in the 15th Dragoons, although utterly unfitted for military service. Friends secured his discharge and shortly afterwards he met Southey with whom he became very intimate. He went to live in Bristol, where in 1795 he began to lecture on politics and religion. His first volume of poems was published shortly after this, and some prose works, mostly concerned with politics. He was thinking of becoming a unitarian preacher when he met Wordsworth. A deep and sincere friendship sprung up between Wordsworth, his sister, Dorothy, and Coleridge. One evening when Wordsworth and Coleridge were walking near the Bristol Channel, the poem *The Ancient Mariner* was visualised. It was to be a joint work, but it soon became apparent that the poem could be written by Coleridge only, so Wordsworth relinquished his part in the work. In 1798 it was published, together with other poems by both Wordsworth and Coleridge, in a book called *Lyrical Ballads*. Shortly after this, Coleridge left England for Ratzeburg, Germany. Here he studied the language so assiduously that he was able to translate the whole of *Wallenstein* in six weeks. On his return to England he went to live among the Lakes with Southey, who, together with Wordsworth and Coleridge, formed the group of "the Lake poets."

Among the further activities of Coleridge were, a tour in Scotland with the Wordsworths; visits on several occasions to London, where he was always popular; a number of lectures with varied success; founding a

magazine, which, however, was discontinued after eight months; and many articles written for newspapers. In 1816, having failed to conquer a craving for opium, he entered James Gillman's house, where he remained until his death, writing continuously.

He had considerable influence during his lifetime—his powers as a critic and his unique imaginative gift as a poet gave him an assured place among the poets of the day. To-day, his place as a great imaginative poet is undisputed: in no work has the supernatural been so remarkably portrayed as in *The Ancient Mariner*.

He had a responsive nature and thus much of his poetry consists of mere fragments. As a religious thinker of his day the fact that he reached Christianity through stages of unitarianism, rationalism, and pantheism made him a notable figure. He wrote a great deal of prose which was widely read, expounding his religious and political theories.

His great poems are few, but of the highest quality.

The Ancient Mariner; Christabel; Kubla Khan; Youth and Age. Among his prose works the following are still read:—*Biographia Literaria; Aids to Reflection; Confessions of an Inquiring Spirit.*

BYRON, GEORGE GORDON, LORD. 1788–1824. English poet, was born in London and spent the first years of his life in Aberdeen. His childhood was exceedingly unbalanced, as he was the object, now of extreme affection lavished on account of his good looks, now of bitter scorn at the disability caused by physical deformity. Better times came when he was sent to Harrow where he made many friends.

He then went to Trinity College, Cambridge, before succeeding to the family title and becoming the owner of a country house in Nottinghamshire. He took his seat in the House of Lords and then undertook the "Grand Tour" fashionable at the time for the accomplished young man. On returning, his first speech in the House of Lords won him a reputation as a rising statesman and added to his fame already earned by his poetic ability.

He lived for a little time in London, leading a life of great social activity, for he had a charming nature and was welcomed at all important functions. In Switzerland he met the Shelleys, with whom he became very friendly. Later, he went to Venice, where he lived for three years in a state of great bitterness of mind, owing to domestic troubles. From that time dates the period when the real Byron is seen. Through tragedy he rose to reveal the genius that had been hidden beneath the vanity of the darling of fashion.

He returned to his apartment at Ravenna, and here his literary work went on apace until he left for Pisa, where he was once more surrounded by his friends, including Shelley and Leigh Hunt. The tragic death of Shelley while sailing in the Gulf of Spezia caused Byron great sorrow.

After this event, Byron went to Genoa, where his greatest work, *Don Juan*, was completed. At this time the Greeks were struggling for their independence, and Byron determined to help them. Though his health was by no means good, he went to Greece itself, where he drilled troops and helped in the organisation. A few weeks later he fell seriously ill and died on Easter Monday, April 19, at the age of thirty-six years. His

body was embalmed and lay in state whilst there was general mourning for twenty-one days. After years of exile from his native land he returned to be buried in the village church of Hucknall-Torkard.

Byron was always ready to help the needy, for he had known poverty, and the sympathy he felt made him kind and gentle. A passionate believer in what he thought was right, his support of the Greeks showed that he was ready to support his convictions. He was vain, for he had a face which has been described as "beautiful;" he was very sensitive about his lame foot; he loved display and richness; yet he had many noble qualities which never deserted him.

His poetry is full of his own experiences and emotions—when he is writing about himself, as *Don Juan*, his work is at its best. His style is slightly humorous, and slightly realistic; it is satirical, but it is also philosophical. He is one of the greatest analysts of human nature. In his poetry there is a shrewd summing-up of the failures, weaknesses, and disillusionments from which man suffers, but there is no vindictiveness in his revelations.

Some of his lyrics are full of a tender beauty and a musical choice of words typical of poetry at its best.

Among his most famous poems, the following may be mentioned:—*Don Juan*; *Beppo*; *The Prisoner of Chillon*; *Childe Harold*; *The Corsair*; *Cain*; *Manfred*; *The Bride of Abydos*.

SHELLEY, PERCY BYSSHE. 1792–1822. English poet, was born at Field Place, near Horsham, Sussex. He was sent to Eton at the age of twelve, where he was known as "mad Shelley" and "Shelley the atheist,"

for he had revolutionary ideas, objected strongly to discipline and custom, and was possessed of a wild, unbounded imagination. His first book of poems was published shortly after he left Eton, when he was eighteen years old. He then went to Oxford, where he became friendly with Thomas Hogg. Hogg had some influence over the enthusiastic Shelley, and together they would argue on abstruse subjects until their ideas became ungovernable. The result of this was that they planned a pamphlet entitled *The Necessity of Atheism* which caused them both to be expelled from the university. They went to London, but Hogg left Shelley to go to New York, and Shelley lived on alone with the little pocket money his sisters managed to save up and send to him. Later, for a year or two he lived an eventful life in Sussex and Wales. Once, he was attacked by some shepherds who resented his humanitarian efforts at ending the miserable lives of diseased sheep. On returning to London, his first great poem was produced, *Queen Mab*. Shelley now came greatly under the influence of Godwin whom he admired immensely. He was still poor, but in 1815 he inherited the family property and was able to settle in a house near Windsor forest.

The next year he went to Switzerland, where he met Byron for whom he had the greatest admiration. He returned again soon afterwards and met Leigh Hunt, who helped to improve his reputation as a poet. In 1818, this time in Italy, he continued his friendship with Byron and, meeting one of the pioneers of the Greek struggle for independence, was inspired to write his great poem *Hellas*.

Shelley's death was a tragedy. He and a friend set

out one day in a little boat, the *Ariel*, to cross the Gulf of Spezia to meet Leigh Hunt. On the return journey, some days later, Shelley, his friend and a sailor were drowned in a storm. His body was burned, according to the custom of the ancient Greeks, on the sea shore, and his ashes were buried in the Protestant cemetery in Rome.

In character Shelley was revolutionary and destructive of accepted conventions: yet he was courageous, enthusiastic, generous, and capable of great affection. Of all the poets of the great romantic revival, he is unsurpassed for his high idealism, for the sheer beauty of his lyrical powers, for the height of his imaginative gift, and the wonderful music of his poetry. He was extremely versatile, producing poems of great dramatic power as well as lyrics of a fragile flowerlike quality. His fame grew up after his death: he died believing that his poems had been refused by the world.

The following are among his best works:—*Prometheus Unbound* (considered to be his masterpiece); *Hellas*; *Adonais* (in memory of Keats); *The Revolt of Islam*; *The Witch of Atlas*; *The Cenci*; *Epipsychidion*; *Queen Mab*; *Alastor*; *To a Skylark*; *Ozymandias*; *Invocation*; *The Question*; *Ode to the West Wind*; *To the Moon*; *The Recollection*; *The Invitation*; *Stanzas Written in Dejection Near Naples*; *To the Night*; *Love's Philosophy*.

KEATS, JOHN. 1795–1821. English poet, was born in London. At school the young John was gay and full of a determination and high spirits which made him a good companion. On the death of his mother in 1810 he was apprenticed to a surgeon, but he spent a great deal of time with Cowden Clarke, the son of

his old headmaster, and it was he who lent John the copy of the *Faerie Queene* which inspired him to his first efforts at poetry.

In 1814 he went to London, studying medicine at Guy's and St. Thomas', but his real passion was becoming evident and in 1817 he decided to devote himself entirely to poetry. Clarke visited him in London and after an evening spent with him in the study of Chapman's *Homer*, Keats wrote the famous sonnet *On First Looking into Chapman's Homer*.

Later he met Leigh Hunt and the resulting friendship had a bad effect upon his work, for he began to imitate Leigh Hunt's loose form of heroic couplet which often fell into a slack and flippant type of dialogue. Leigh Hunt and his followers earned the title of the "Cockney school," and many bitter attacks were launched against them.

Keats settled with his delicate brother Tom at Hampstead and began to work seriously. His first long poem *Endymion* was written during this period. After the publication of this work he went for a walking tour with some friends, but symptoms of tubercular trouble began to appear. On his return he found that the attacks against the "Cockney school" were being directed against himself, and this, together with his ill health and the death of his brother, upset him greatly. He fell into deepest despair and contemplated giving up writing poetry altogether, but was persuaded to continue. He worked exceedingly hard, but, his health giving way under the strain, he went in 1820 to Naples and then to Rome, where he stayed until his death.

By nature Keats was gay and full of a capability of enjoyment. He worshipped beauty and the intensity

of his faith was immortalised in exquisite verse. He had, however, a melancholy strain in his character augmented by the realisation that he was doomed to an early death. The consequent doubt that he would be unable to fulfil his great poetic mission caused him much sorrow, but probably gave us the greatest of his writings.

"When I have fears that I may cease to be
Before my pen has glean'd my teeming brain . . ."

Keats never realised that his works were destined to rank amongst the greatest of all time.

The following poems are memorable:—*Endymion*; *Hyperion*; *Eve of St. Agnes*; *Ode on a Grecian Urn*; *To a Nightingale*; *Ode to Autumn*; *La Belle Dame Sans Merci*; *On First Looking into Chapman's Homer*.

BROWNING, ELIZABETH BARRETT. 1806–1861. English poetess, spent a happy childhood in the country, greatly loved by her somewhat autocratic father. She began to write early, and in 1819 her father had printed for her fifty copies of what she called her "great epic of eleven or twelve years old." She studied Latin and Greek and later translated *Prometheus Bound*. The Barretts left their country house in 1832 and settled in London in Wimpole Street.

Elizabeth was a delicate girl and when she left the country her illness became more acute and she had to go to Torquay, with her favourite brother. Here tragedy came into her life, for her brother was drowned in Babbacombe Bay. Feeling partly responsible for this she immersed herself in hard work as soon as she

was physically strong enough. Soon after this she met Robert Browning and in 1846 the two poets were married. They left for Italy where they remained on account of her delicate health. She wrote a great deal of poetry, and during her lifetime her work was appreciated more than that of her husband.

Her poetry is emotional, but this is the result of a restless mind rather than of mere femininity. There is an eagerness, a spirituality and a freshness of thought which gives her a high place in literature.

The following works should be noticed:—*Sonnets from the Portuguese*; *Aurora Leigh*; *The Musical Instrument*; *The Lost Bower*.

TENNYSON, ALFRED LORD. 1809-1892. English poet, was born at Somersby, Lincolnshire, one of a family of twelve children. At a very early age Tennyson began to write both in prose and poetry; at the age of twelve he had written what he called "an epic of 6,000 lines" and he had also written dramas in blank verse. He was sent to the Grammar School at Louth when he was six, but returned home, where he was taught by his father and amassed a considerable wealth of knowledge in the huge rectory library. In 1827 Alfred with two of his brothers produced a book of verse; later he went to Trinity College, Cambridge, with his brothers. A prize for a poem in Miltonic blank verse brought him into prominence. He worked hard at his poetry during his university days, and Arthur Hallam recognised the genius in his early lyrics, which appeared in a book in 1830. On the death of his father, Tennyson lived on at the rectory. He was an excellent athlete, but soon his eyes began to trouble

him and he was forced to give up many of his physical activities. In 1832 appeared another book of verse containing such famous poems as *The Lotos Eaters*, *The Lady of Shalott* and *The Miller's Daughter*. One year after this Hallam, his dearest friend, died in Vienna. The news affected Tennyson deeply and he retired more and more from public life. The exquisite *In Memoriam* was a tribute to the memory of his great friendship. Soon after this the Tennysons were forced to leave the rectory and finally settled near Maidstone.

In 1842 he published another book of poems. It is from this date that he was recognised as one of the leading poets of his age, and he made many friends, amongst whom were Dickens, Carlyle and Elizabeth Barrett. He suddenly lost all his money in a false speculation and became exceedingly ill. Recovering, he began to work again, with the help of an annuity bestowed upon him by the government. He was married in 1850, the same year that Queen Victoria appointed him poet laureate, and lived very happily until his death.

Tennyson frequently suffered from fits of depression and was greatly plagued by sightseers anxious to gain a glimpse of this famous poet. In 1883 he accepted a peerage from Gladstone, but never spoke in the House. His popularity was incredible; never before had a poet held a position of such influence and unbroken popularity as Tennyson. Untiring to the very last, he was over eighty years old when he published his final book of poems. On his death he was given a public burial in Westminster Abbey.

Tennyson was tall and majestic in bearing; he had

a shock of unruly hair, and was an awe-inspiring figure as he strode along with his cloak swinging loosely on his gaunt figure. Yet, in spite of his fierce and unapproachable aspect, he was very shy and affectionate by nature.

Tennyson is famous chiefly as a lyrical poet of unsurpassed beauty. The keenness of his observation, his sympathy, his deep and sensitive understanding of human nature, and above all the exquisite beauty and vividness of his style have earned for him his reputation as one of the greatest English poets. He was also a student of literature and his appreciations of contemporary poets are among the best.

The following are his most famous works:—*Maud*; *In Memoriam*; *The Princess*; *The Idylls of the King*; *Ulysses*; *The Lady of Shalott*; *The Lotos Eaters*; *Oenone*.

BROWNING, ROBERT. 1812–1889. English poet, was born at Camberwell. His family was a most affectionate one and his childhood happy. His father helped him with his early attempts at poetry writing, for as a boy he started to compose poetry even before he could write. At school he was not very popular, for he was aloof and despised his companions, much preferring the company of birds and animals, although he used to make his schoolfellows act the many plays he wrote. He read a great deal, at the same time developing that originality of character and strength of will which marked his personality. He admired the works of Shelley and was much influenced by this poet in his earlier writing. He wrote several plays, being passionately fond of the theatre, and these, together with his poetry, established for him a reputation among

the young poets of the day. In 1846 he married Elizabeth Barrett, and soon afterwards he and his wife went to Italy where they lived for the next fifteen years. Thus much of Browning's work became pervaded with an Italian atmosphere.

After his wife's death, Browning returned to England, where he associated with people more than he had been accustomed to do and made many friends. He continued his writing almost until his death, which occurred suddenly in 1889.

The main characteristics of Browning's poetry are an obscurity and a daring originality of thought which occasionally scandalised contemporary readers. His work is dramatic in style and is pervaded with the character of its author—a determinedness and a high idealism and a very subtle insight into character. He sympathised with men of all stations of life but abhorred falseness and perfidy. Some of his lyrics are very lovely and in some of his longer poems there are flashes of purely descriptive work which is of the highest standard. He was chiefly interested in the study of psychology and the effect certain unhappy experiences had on men's minds, yet throughout all his work there is the expression of his high ideals which counterbalances the somewhat morbid theme of some of his stories.

Among his most important works are *Porphyria's Lover*; *Pippa Passes*; *Sordello*; *Saul*; *Paracelsus*; *Strafford*; *The Ring and the Book*. A few of his lighter works such as *Home Thoughts from Abroad*; parts of *Pippa Passes*, part of a poem called *By the Fireside*, *The Pied Piper* and *How they brought the Good News* are greatly appreciated by children.

64. Poets—2. (*Vol. I., p. 343.*)

CHESTERTON, GILBERT KEITH. 1874-1936. English poet, critic and essay writer, was born in London and educated at St. Paul's School, after which he determined to study art. It was found, however, that he had a natural literary bent and he served the usual apprenticeship of journalism and reviewing, although he still retained a talent for drawing of a distinctive kind. He lived in London, writing regularly. He took a keen interest in politics, and after World War I became a leader of the Distributist movement, an attempt to abolish capitalism and socialism and establish some other economic system. In 1922 he was received into the Roman Catholic Church, an event of great importance in his life. He visited America, lecturing, and as a tribute to his work held many honorary degrees.

His reputation as a man of letters began with a brilliant study of Browning published in 1903; it was assured by his *Charles Dickens* which has been described as "one of the best critical studies in the language." He is famous as "the master of paradox," for, although he was conventional and somewhat conservative, he scoffed at conventionality in a truly Falstaffian manner. No one was more convinced than he of the truth of his own ideas. His style in his poetry is varied, but he is a master in the craft of rhetorical verse. It is not, however, in his poetry that the real genius of Chesterton is apparent; it is in his prose that his whimsicality, his penetrating insight and his creative gift are shown to their best advantage.

His *Father Brown* stories are famous throughout the world, while the following works are of a high order:—

Charles Dickens; The Man Who Knew Too Much; A Short History of England; Magic; Lepanto; The Ballad of the White Horse; The House of Christmas; The Flying Inn.

DAVIES, WILLIAM HENRY. 1871-1940. Welsh poet and writer, was born at Newport. He left school at a very early age and was apprenticed to a picture-frame maker, but later went to America, where he lived as a tramp for many years, passing through innumerable vicissitudes. One day, falling from a train on which he was having a stolen ride, he injured his foot, with the result that his right leg had to be amputated. This put an end to his wandering life and he returned to England where he lived as a pedlar and street singer for some time. When he was thirty-four years old he blossomed out as a poet and in 1921 he became editor of *The Forum*. From that time he wrote a great deal and became one of the leading poets of his day.

His work has a simplicity and charm which can be described as "childlike." He accepts things without painful researches into the why and wherefore; he writes about simple things as he sees them with a delicate turn of phrase which makes familiar objects things of mystery and unexpected beauty. His observation is acute; he writes about birds and animals with a real knowledge, and has a great love for children. Perhaps the most arresting point about his poetic style is its singing quality. The verses seem to run along to some unknown tune; there is a lilt and a happy spirit in them that infects the reader. It is this happiness and his charming spontaneity which made him a very popular poet.

His book *The Autobiography of a Super-Tramp* gives an account of his vagabond life, whilst the following short poems are favourites:—*Leisure; The Kingsfisher; A Great Time; The Moon; Early Spring; The Best Friend; The Sluggard; Sweet Stay-at-Home; Days that have Been.*

DE LA MARE, WALTER. 1873-. English poet and writer, was born in Charlton, Kent. He is of Huguenot descent and related to Browning. After being educated at St. Paul's Choir School where he founded the *Chorister's Journal*, he went into business in London, but he had already begun to write under a pen-name, and in 1901 his *Songs of Childhood* appeared, quickly followed by his novel *Henry Brocken*. He was given a government grant and was thus enabled to devote himself entirely to literary work. He gradually became very popular and is now one of the leading modern poets.

His style is his alone. He appears to be unable to differentiate between the real and the unreal and, being a master at his craft, he makes the reader unable to distinguish between them, so that he, too, believes in his shadowy imaginary characters just as the poet believes in them. We find ourselves in a world where mystical "impossible" people are not only alive but quite naturally so. He is a master of fantasy and of words and rhythm. He is in every sense of the word a true artist.

Among his works the following are notable:—*Henry Brocken; The Return; Memoirs of a Midget* (novels); *The Listeners; Nod; The Supper; Tartary; The Linnet; The Scribe; Echo Haunted; Farewell; All that's Past; Silver.*

DRINKWATER, JOHN. 1882-1937. English poet, born in Leytonstone, Essex. He was educated at the Oxford High School and then became a clerk in an insurance office. After twelve years of this life he became interested in the theatre and was made the manager of the Pilgrim Players, which later developed into the Birmingham Repertory Company. He then began to write plays and to publish poetry; he also wrote several critical studies and essays of outstanding excellence. As a philatelist he was regarded as a specialist on stamps of the U.S.A.

He was most famous as a playwright and his play *Abraham Lincoln* has been produced with success in both England and America. *Oliver Cromwell*; *Mary Stuart*, and *Robert E. Lee* are other good historical plays. In 1925 his most important prose work was published—*The Pilgrim of Eternity: Byron, a Conflict*. Among his poems the following should be noticed:—*Holiness*; *The City*; *The Death of Leander*; *Moonlit Apples*; *Who were before me*.

FLECKER, JAMES ELROY. 1884-1915. English poet, was born in Lewisham, a suburb of London. His father was head of Dean Close School which Flecker attended until he went to Uppingham. He wished to enter the consular service and for that reason studied oriental languages at Cambridge, and in 1910 was sent to Constantinople (Istanbul). His first book of poems was published during that year. He was unable to remain abroad for long, for his health broke down and he returned to England. He went to a sanatorium but was discharged the next year as cured and was sent to Smyrna. Later, at Athens, he fell ill again and went

to Switzerland in the hope of being cured. Two years afterwards, he died at the early age of thirty-one.

In spite of the fact that Flecker's life was spent in fighting the ill health which gradually caused his death, the quality of his work is very high. It is marked by an originality of metre and rhythm and a high idealism and worship of beauty, tinged with fatalism, that has assured for him a permanent place in English literature. His work shows the influence of the oriental atmosphere in which part of his life was spent, and his famous play, *Hassan*, is set in the colourful scenes of the East. This play contains some pieces of lyrical poetry which are exquisite, and with its humour, whimsicality, tragedy and beauty makes fascinating reading.

Among his shorter poems should be noted:—*Santorin*; *The Old Ships*; *The Golden Journey to Samarkand*; *The Town Without a Market*; *A Ship, an Isle, a Sick Moon*; *The Dying Patriot*; *Tenebris Interlucentem*; *War Song of the Saracens*; *Serenade to Yasmin* (from *Hassan*).

GIBSON, WILFRID WILSON. 1878– . English poet, born in Mexham, Northumberland. He was educated at private schools and began writing when a boy. During World War I he served as a private, afterwards occupying himself in social work in the East End of London. Later, he went to America where he delivered a series of lectures. He has produced a great deal of poetry but believes that his greatest work is yet to be written. He is a stern realist. Together with Rupert Brooke and John Drinkwater, he was one of the leaders of the Georgian school of poets who protested against the stupidity and "prettiness" of post-Tennyson poetry. He loves simple country folk

and uses his native Northumberland to form the inspiration for much of his work. He is mainly concerned with the welfare of poor people and with their problems and difficulties. His poetry is marked by sincerity and by a gift for telling a story.

The following poems are important:—*The Lighthouse; Tenants; Flannan Isle; The Ice-cart; Lament; The Golden Room; Akra the Slave.*

KIPLING, RUDYARD. 1865–1936. English poet and writer, was born in Bombay, India. Kipling lived in India as a child, and was then sent to England to be educated at the United Services College, Westward Ho, Devon, the scene of short stories, *Stalky & Co.* Afterwards he returned to India, where, at the age of seventeen years, he became assistant editor of the *Lahore Civil and Military Gazette*. He began to publish both prose and poetry and before he was twenty-four he had already a reputation as a story-teller of remarkable capabilities. He left India, and after travelling through China, Japan and America he landed in England to find himself already a popular and well-known writer. Up to this time he had written chiefly in prose, though *Departmental Ditties*, a book of light verse, had been published some time previously, but now he began to write more in verse and his genius in this direction soon became apparent. Kipling then lived for some years in America, before he settled down in England. In 1898 he went to S. Africa for the first time and he was there during the Boer War. In 1902 he went to live in a beautiful house at Burwash in Sussex, where he remained until his death, which occurred a few days before that of King George V.

Kipling achieved great fame during his lifetime. He was the first Englishman to receive the Nobel prize for Literature, and *The Smith Administration* was auctioned for fourteen thousand dollars, the highest price paid for any living author's work. He was made a foreign associate of the Académie des Sciences Morales et Politiques, King Albert of Belgium and Cardinal Mercier being the other two recipients of the honour.

Kipling's genius and popularity need not be questioned; his *Jungle Books* alone are enough to warrant a lasting reputation. His poetry describing soldier life is in a half-satirical, wholly sympathetic manner, with a vigour of style and an unconventionality of phrasing and form which make inspiring and lively reading. He has written other poems of a more serious and reflective nature, and his well-known *Recessional* is perhaps the most popular of all his works. His imperialism, his idealism and his kindly yet acute insight into human nature are as apparent in his poetry as in his prose.

His output was enormous, but the following works should be specially noticed:—

Poetry:—*Departmental Ditties; Barrack Room Ballads; Recessional; Fear; The Children's Song; If.*

Prose:—*The Jungle Books; Puck of Pook's Hill; Kim; Stalky & Co.; The Light that Failed; Rewards and Fairies;* and many short stories of great merit.

MASEFIELD, JOHN. 1875— . English poet and writer, was born in Ledbury, Hereford. His father was a lawyer, but he was left an orphan at an early age and at fourteen years old he went to sea. He loved the life and his poetry is full of his experiences

and adventures. He then spent several years in America, earning a living as best he could, and it was during this time that he read Chaucer's *The Parliament of Fowls*, the book which roused in him a desire to write poetry himself. He returned to England in 1897, but it was not until 1911 that he scored his first literary success with the narrative poem, *The Everlasting Mercy*. During World War I Masfield served with the Red Cross, and in 1930 he succeeded Bridges as poet laureate. In 1948 he was made a Companion of Honour.

Masfield's output of poetry is very great, and this, combined with a certain disregard of careful technique, has helped to injure his reputation as a poet. Nevertheless, his long narrative poems are marked by brilliant colour, dramatic incidents, striking rhythms and human characterisation. He shows a deep and tolerant understanding of human nature, a sense of humour and a love of rousing adventure, all of which appeal to his readers; but to find the real poet it is necessary to turn, not to the popular narrative poems, but to some of his short lyrics and his sonnets. Here, his worship of beauty, his idealism, his love of nature and of the sea find expression in pieces of such charm and real poetry that his true genius is indisputable.

Masfield is a versatile writer, being the author of novels, plays, and a vast amount of poetry all with a wide variety of subject matter and method of treatment, but the following works should be specially noted:—

Plays:—*The Tragedy of Nan*; *Pompey the Great*; *The Trial of Jesus*.

Novels:—*Sard Harker*; *Odtaa*; *Jim Davis*.

Narrative poems:—*Dauber*; *Right Royal*; *Reynard the Fox*; *The Everlasting Mercy*; *The Daffodil Fields*.

Lyrics and sonnets:—*Lollingdon Downs* (a sonnet sequence); *The Seekers*; *Beauty*; *Cargoes*; *The Wild Duck*; *The Tree*.

NEWBOLT, SIR HENRY JOHN. 1862–1938. English poet and author, was born in Bilston. He was educated at Clifton College, later attending Corpus Christi College, Oxford. He studied law at the same time writing a story, *Taken from the Enemy*, which was published in 1892; but it was not until the publication of his ballads, *Admirals All*, in 1897, that he won a literary reputation. This book was followed by others of equally stirring poetry and his reputation was assured. After giving up his work at Lincoln's Inn, he became editor of the *Monthly Review* in 1900. During World War I he was controller of wireless and cables and many of his experiences have been recorded in his verse. He was an ardent patriot and his poems had a patriotic fervour and idealism which was greatly inspiring. These war poems were published under the title *St. George's Day and Other Poems* and later he published a *Naval History of the Great War*. He has also edited several anthologies including *An English Anthology*.

His poetry, while not generally considered of the highest character, contains many poems which will live. He is a poet of perfect technique and artistic restraint: he is imaginative, but applies his imagination only to things which have actually occurred to him, rarely projecting his thoughts into the unknown. He will be chiefly remembered for the poems *Drake's Drum*; *He Fell Among Thieves*; *Gillespie*; *Admirals All*; *Vitai Lampada*; *Clifton Chapel*; *The School at War* and *Devon*.

Novels:—*The Old Country*; *The New June*.

NOYES, ALFRED. 1880- . English poet, was born in Staffordshire. He was educated at Exeter College, Oxford. When he was twenty-two his first volume of poems appeared, *The Loom of Years*, and in 1910 the first of a series of his *Collected Poems*. He published poems of the sea in 1907 and 1908, and later went to America, where he delivered a series of lectures. These were subsequently published in England under the title *The Sea in English Poetry*. In 1914 he was offered a professorship of modern English literature at Princeton University, which post he held until 1923. He was unable to take any active part in World War I, owing to defective eyesight, but was attached to the Foreign Office in 1916. He contributed freely to *Blackwood's Magazine* and has written plays, poetry, short stories and novels.

His poetry is popular on account of the rhythm, the colour and brilliance of the word pictures, and his ability to tell a rousing story. *The Highwayman* is his most popular poem. Others are:—*The Elfin Artist*, *Seagulls on the Serpentine*; *Drake*.

STEPHENS, JAMES. 1882- . Irish poet, born in Dublin. He had little accepted education but spent his childhood in extreme poverty wandering about Ireland, living as best he could. In this way he learnt a great deal about the Irish peasants, their customs, their beliefs and their problems. He learnt typewriting and obtained a post in a solicitor's office, where G. W. Russell ("A.E."), the Irish poet, found him and recognised his poetic gift. His first volume, *Insurrections*, attracted a great deal of attention, and later he won prizes for some of his work. Since then he has written

a considerable amount of poetry and is now considered a leading poet of the Irish group. He worked hard for the creation of the Free State, now Eire. He spent much of his time in Paris and occasionally went for trips to America.

His poetry is marked by a rare and almost elfin gaiety and an acute sensitiveness of feeling. He loves little creatures, and is hurt by cruelty to anything helpless. He loves, too, the Irish peasants, and makes friends amongst workmen and poor, humble people. He has translated many poems from the Irish.

The following works should be noticed:—*The Shell*; *The Lonely God*; *The Waste Places*; *The Snare*; *In the Poppy Field*; *Hate*; *The Rivals*; *The Crock of Gold* (a novel); *Hunger* (a novel).

YEATS, WILLIAM BUTLER. 1865-1939. One of the foremost poets of the day, an Irishman, was born at Sandymount near Dublin. He went to the Godolphin school, Hammersmith, but his holidays were spent in the wildest part of western Ireland, County Sligo, where he was surrounded by all the old folklore and legend of the Irish peasants. When he was fifteen years old he went to the Erasmus School in Dublin, and then studied art for three years. However, at the age of twenty-one he decided to devote himself to literature, and his first book, *Mosada*, appeared in 1886. He went to live in London and became a member of *The Yellow Book* group, *The Yellow Book* being the name of an illustrated journal to which many famous people contributed.

He was greatly inspired by the Gaelic movement and he helped to found an Irish Literary Society both

in London and Dublin. With the help of friends he managed to found an Irish National Theatre, and in 1899 his play, *The Countess Cathleen*, was produced, English actors taking the parts. It was not until 1902 that his ideal was reached when the play was acted by Irish players. Many versions of some of his poems exist, for he frequently rewrote his work, altering lines and words here and there.

Yeats was considered by many to be the greatest poet of the day. He was a master of the English language—there was no other man who used words with such effect and such delicate and careful choice. For sheer beauty of expression, thought, and lyrical imagination he could not be excelled by any contemporary poet.

The following works should be noted:—*The Land of Heart's Desire; The Countess Cathleen; When You are Old; Aedh Wishes for the Cloths of Heaven; The Song of Wandering Aengus; The White Birds; The Lake Isle of Innisfree; The Sorrow of Love; Down by the Salley Gardens; The Man who Dreamed of Faeryland.*

65. Slotted Disc Apparatus. (*Vol. II., p. 259.*) The apparatus illustrated is very useful for demonstrating the principle of the cinematograph. It differs from the instrument in being a direct vision machine. The appliance can be built with either a single or a double rotating disc system. With a single disc, a plane viewing mirror has to be used, but with a double arrangement the pictures may be observed directly. The drawings, which show the stages of a simple movement in the usual way, are spaced evenly round a circle. Near the edge of a disc of plywood whose diameter equals that of the drawing circle a series of radial slots is cut to

correspond with the pictures. The sheet of pictures is fixed either to the slotted disc itself or to a similar plain one. If the slotted disc is used as a mount for the drawings, then the observer looks through the slots from the side of the disc which is blank and sees the pictures by reflection from a stationary plane mirror fixed at a convenient distance. If, on the other hand, the pictures have a disc to themselves, then they are viewed directly.

The disc or discs are mounted on a shaft and this is supported in suitable bearings so that the discs are in a vertical plane. The side of the plywood nearest to the observer is blackened to prevent the reflection of stray light. The disc shaft is turned either by hand or by mechanical means and the moving pictures are observed through the slots.

66. Story of Travelling—1. (Vol. I., p. 90.)

From Saxon to Elizabethan times. The usual mode of travelling in Saxon times was on foot. Conveyances for travellers were not much used in England until the beginning of the seventeenth century. In early Norman times we read of monks who walked to Rome, and of pilgrims who walked across Europe to the Holy Land: the great army of crusaders mostly travelled on foot.

Soon after the Conquest the use of carriages was for a time forbidden, as it was thought that men who rode about would be less fit for hardships of war; men of all grades and professions rode on horseback, or on mules, and sometimes the monks and women on she-asses. The poet Chaucer, who lived at the end of the fourteenth century, did not mention any of the pilgrims in his *Canterbury Tales* as travelling in conveyances.

LITTER. This is taken from an old sketch of an eleventh-century cart: how the travellers got into it is not shown, but it must have been very uncomfortable, swinging from side to side with every movement of the horse.

ROYAL TRAVELLER. This cart was gaily decorated and hung with curtains, but being springless it must have bumped rather badly on the rough, uneven roads. Finely decorated and upholstered carriages were known at this time, for we read in an old rhyme of that period:

“ To-morrow ye shall on hunting fare
 And ride, my daughter in a charc.
 It shall be cover'd with velvet red
 And cloth of fine gold all about your head,
 With damask white and azure blue
 Well diaper'd with lilies new.”

COVERED CARRIAGE. Covered carriages on four wheels—the beginning of coaches—were known in the fifteenth century, but their use was only for ladies of high rank; towards the end of this century, however, they began to be used by kings and princes in journeys. Such a carriage had a canvas top with a diapered pattern worked on it, a box for luggage, and upholstery inside.

DUKES TRAVELLING. This was the usual means of travelling in the Middle Ages. Here are the Dukes of Exeter and Surrey riding from Conway Castle, where King Richard II had taken refuge, with a message to Henry of Lancaster, to whom the King shortly

afterwards surrendered, 1399. There is little in their dress to distinguish them from women, but they looked resplendant in their gay clothes, the trappings of their horses, and their escort of bowmen.

ELIZABETHAN COACH. A coach of Queen Elizabeth's maids. The chief reason why roads were neglected and conveyances little used was that the main work of the people was on the land; each village was able to supply practically all the wants of the people. In Saxon times the only cart that was used at all was the bullock-cart.

67. Story of Travelling—2. (*Vol. I., p. 91.*)

From Stuart to Modern times.

COACH. By the beginning of the 17th century coaches had become so common that the Thames watermen complained bitterly against this new-fangled way of travelling:

“Carroaches, coaches, jades, and Flanders mares
Doe rob us of our shares, our wares, our fares,
Against the ground we stand and knock our heels
Whilst all our profit runs away on wheelles.”

In the early part of the century it was estimated that there were 6,000 coaches in London and the surrounding country. This coach of Charles II's time shows a great advance in coach-building, for the domed body is hung by means of stout leather straps from the four corners to pillars erected upon the under-carriage. From this time onwards to the coming of railways great progress was made. The present coach of the Lord Mayor of

London, which is hung on leather braces and has beautiful gilding and panel work, was first used in 1757; the royal state coach of the present king, "the most superb carriage ever built," was completed in 1761.

POST-CHaise. A chaise in which one *posted* from town to town, hiring fresh horses at posting-stations on the route. This was for travellers with plenty of money: it had upright springs, from the end of which the body was hung on leather straps, the luggage being carried on the roof, on the transom in front, and on the back axle-tree. Elliptical springs, on which the body of the conveyance rests, were not invented until 1804.

SEDAN CHAIR. In the towns the sedan chair was a fashionable mode of transit for those who did not care to walk in the miry, and, at night, ill-lighted streets. It took its name from the town of Sedan, in France, where it was first used, and was introduced into England in 1634, but it is specially a vehicle of the eighteenth century, the time of wigs and three-cornered hats.

CITIZEN and WIFE. This method of travelling (pillion) long continued to be the only reasonable means of getting from place to place on hundreds of the narrow tracks which did duty for roads.

STAGE COACH. This noted vehicle was known in England from the sixteenth century. In 1673 there were coaches travelling between regular *stages*, from London to York, to Chester, and to Exeter, having forty horses on each route and carrying six inside passengers. The coach took eight days travelling to Exeter. In 1706 a coach went from London to York

every Monday, Wednesday, and Friday, performing the journey in four days. The difficulties of the journey were very great, not only due to the awful state of the roads, in some of which were holes deep enough to bury a horse, but also on account of highwaymen. Poor people travelled by stage-waggons, which were rumbling, slow moving, covered carts, that carried goods as well as passengers; rich people travelled by post-chaise.

RAILWAY TRAIN. One of the first railway trains to run on the Manchester to Liverpool railway, opened in 1830. Several inventors had used engines for hauling coal from the pits, but the first real progress was made in 1814 when Stephenson invented an engine which ran on metals, but several years passed before engines were used for passenger traffic. The Stockton and Darlington Railway was opened for traffic in 1825, and five years later Stephenson's *Rocket* travelled at the rate of thirty-five miles an hour from Liverpool to Manchester. Nearly all the great railway lines were established between 1844 and 1850.

68. Story of Lighting. (*Vol. I., p. 11.*) It has been said that "Man is scarcely man till he is in possession of fire." Over the whole earth no tribe of people without fire has been found, but in very early times its coming was a source of mystery and caused many curious beliefs, the story of Prometheus stealing fire from the gods being perhaps the best known. So many were the benefits of fire that instead of keeping a fire always burning or carrying it from place to place, man discovered how to make it for himself, after noticing perhaps an accidental fire caused by a heavy stone

striking rock containing iron, or by dead branches of a tree rubbing together in the wind.

ABORIGINES. This shows a method of making fire by friction. In skilled hands fire is produced in a few seconds, and although it has been seen often amongst natives in Africa, both Americas, and Australia, rotating a stick is too laborious for the white man.

ROMAN LAMP. From fire making, the lamp was a great step forward as it helped to lessen the fear of darkness. Lamps dating as far back as 2000 B.C. have been found in Palestine. This one, with a spout in which the wick burned, a hole for the oil and a handle, was very common in Mediterranean countries in the fourth century B.C. Sometimes they were modelled, generally from clay and bronze, in fantastic shapes of gladiators or of animals, or in a design taken from a legend.

TINDER BOX AND CANDLE. Producing light by percussion was not important until steel came into use. The tinder box with its flint and steel was very common until the nineteenth century, when sulphur matches were introduced. From rushlights, the tallow candle was a short step. These were usually made at home by repeatedly dipping a wick of flax in melted fat and cooling until the right thickness was obtained. In Paris in the thirteenth century there was a guild of travelling candlemakers.

FLAMBEAUX. Usually associated with the draughty passages in castles, they are used here for lighting the entrance to a house in the days when street lighting was unknown. The iron cup contained pitch-smeared rope.

CRESSETS used by street watchmen on their rounds, also contained pitch-smeared rope. They were sometimes fixed, serving as street lamps, whilst at other times they held beacon fires.

LINK BOY. He was a familiar sight in the eighteenth century as he showed the way for the chairman with his link or torch. Extinguishers for these torches can still be seen on many of the old City houses. Sometimes he was not always to be trusted, as the following verse shows:—

“ Though thou art tempted by the Linkman’s Call
Yet trust him not along the lonely Wall;
In the Midway he’ll quench the flaming brand
And share the booty with the pilfering Band.”

LONDON WATCHMAN. The old watchman who was supposed to guard the streets of London at night marks the last stage before modern lighting appliances came into use. He carried a lantern and a staff, and every hour walked his beat crying the time and the state of the weather: “One o’clock and a frosty morning!”

69. Transmission of News—1. (*Vol. II., p. 530.*) The oldest known method of conveying messages over considerable distances was by means of fire and smoke signals. Two examples of this type of communicating news are shewn, the fiery cross which meant that the bearer carried news, and the beacon or cresset on a tower, used for prearranged signals. A famous example of the use of beacons occurred in Queen Elizabeth’s reign when the approach of Philip of Spain’s great armada was signalled by the lighting of a magnificent

chain of beacons all over the country. The harper, the pedlar and the pilgrim were all carriers of news by word of mouth in the mediæval times when there were no newspapers and people in the villages were isolated through difficulties of roads and conveyances. These wandering people were welcomed as much for the latest news as for their wares. Later, in the 17th century, news was brought from abroad by means of ships, and important dispatches were carried overland by swift post horses.

Below, the two pictures illustrating the news carriers of to-day (postal service and newspapers) show the great development that has occurred since early times.

70. The Transmission of News—2. (*Vol. II.*, p. 531).

Further modern developments in the conveyance of news are here shown. As one of the chief requirements to-day in obtaining information is speed, many inventions have come to the fore either to quicken the carriage of the written word or to avoid the protracted system of word-making altogether. The carrier pigeon, the express train, the fast mail boat and lastly the aeroplane all show the tendency in the first case.

In the second, the semaphore system, shown by the sketch of the sailor, proved an excellent visual means of sending words, letter by letter. Mechanical semaphores were in vogue as far back as 1793, when messages were first sent directly from Paris to Lille. Many stations were erected in England and a short test message was once sent by thirty-one relays of signallers from London to Plymouth and back in three minutes. The disadvantage of visual transmission lies always in its dependence upon clear weather.

The invention of the Morse code (combinations of dots and dashes to replace letters and figures) in connection with the discovery of electricity form the basis of the amazing rapidity of modern methods and instruments. In regions of brilliant sunshine and good visibility, the heliograph is still in use. This apparatus, which has been known in the Himalayas to convey a message no less than 70 miles, consists of mirrors adjusted on a tripod and manipulated by a key that taps the required dots and dashes.

Electrical instruments, less dependent on weather, have of course superseded the heliograph for general use. To-day, overhead telegraphs, under land and sea cables, telephones, and wide-stretching wireless stations all assist in bringing to the family by the fireside news of happenings that may even be still in course of progress on the other side of the world.

71. Alphabet of Architecture—1. (*Vol. VIII., p. 278.*)
This Plate is suitable for a Lecturette.

AISLE. The wing or side passage of a church.

APSE. An arched recess at the east end of the choir of a church.

ARCADE. A series of arches, either open, or closed with masonry, supported by columns or piers.

BASE. The foot, or lower part of a pillar.

BATTLEMENT. Parapet on top of a wall or building, with openings, or embrasures, formerly used by sentries and bowmen.

BOSS. Raised ornament, or knob, placed at the meeting-points of the ribs of a ceiling.

BUTTRESS. Projecting support built on to the outside of a wall.

CAPITAL. The head or top part of a column, or pillar.

COLUMN. A round pillar.

COPING. The capping, or covering course of masonry of a wall.

CORBEL. A projecting stone, or piece of timber, which supports a weight above it.

CORNICE. The level moulding at the top of a wall, generally beneath the eaves.

DOVE. A large cupola; a structure raised above the roof of large buildings, generally half-circular in shape.

FOILS. The *spaces* between the cusps, or projecting portions of feathered arches.

FLYING BUTTRESS. An arched buttress built to support certain parts in the outside of a wall.

GABLE. The part of a wall, above the eaves, which is shaped to conform to the slope of the roof which abuts against it.

72. Alphabet of Architecture—2. (*Vol. VIII., p. 279*)
This Plate is suitable for a Lecturette.

GARGOYLE. A projecting spout used to throw the water from the gutter of a building off the wall.

LANTERN. A small structure on the top of a dome to give light and to crown the fabric.

MOULDING (Egg and Dart). Ornamental projections, or cavities, forming the outline of cornices, capitals, bases, etc.

NEWEL. The central column round which the steps of a circular staircase wind.

NICHE. A recess in a wall for a statue, vase, or other similar ornament.

OYLET. A small opening, or loophole, to admit light, or for the discharge of missiles in the walls of fortifications.

PARAPET. A breastwork, or low wall, used to protect the ramparts of military structures, and the gutters, roofs, etc., of churches, houses, and other buildings.

PEDIMENT. The triangular termination used in classical architecture at the ends of buildings.

PILASTER. A square pillar usually attached to a wall.

PILLAR. The column supporting an arch.

PINNACLE. A small turret, usually tapering towards the top, often placed above a buttress.

PISCINA. A shallow stone basin, placed near the altar, with a hole in the bottom to carry away any water which may be put in it by the priest, after washing his hands, etc.

SPIRE. A tower of a church, or building, ending in a point, usually very high.

STEEPLE. The tower of a church, or other building, which may include a spire or lantern above it.

TRACERY. Ornamental stonework in the upper part of windows.

VAULTING. Arched roofing.

ZIGZAG. A decorated moulding running in zigzag lines, specially used in the early Norman style of architecture.

73. Story of Writing—1. (*Vol. IV., p. 562.*)

PICTURE WRITING. The beautiful drawing of a reindeer carved on a piece of antler by one of the ancient cave men was found near Thayngen, Switzerland, and is an example of an art that became lost to the world.

In the very early days man had to rely solely upon speech and signs if he wished to tell his friends of important happenings.

The next step came when messages had to be sent a distance away. Messengers were not always reliable and, in consequence, various ideas came into use.

MESSAGE STICK. This, still seen in Western Australia, was among the earliest and was not so much a message in itself as a reminder for the carrier, who told his story and referred to his stick to make sure that nothing had been omitted. Such sticks were in use among the ancient peoples of China and America and the notched sticks, the account books and bills of the Serbians, and the tally sticks and clogg almanacs of the Englishman of the Middle Ages are descendants of these.

Another idea was the knotted cord, used by the Chinese, Persians, Mexicans and the Peruvians, who called it the *quipu*.

The American Indians used coloured shells for a similar purpose, and messages were carried on strings made into a many coloured belt or wampum.

Sometimes actual things were sent in order to express a meaning. To the Scythians a frog meant, "Can you leap like a frog through the swamps?" A mouse meant, "Can you hide in the earth like a mouse?" And to the Indians a pipe signified peace; a spear or arrow, war; and a drawn bow, attack. Sending "things" led to picture messages to avoid the nuisance of carrying awkward packages.

ANCIENT ROCK INSCRIPTION. This picture story was found on a cliff near Lake Superior in North

America. Five war canoes are drawn, containing fifty-one braves, the first boat being led by the Kingfisher, whose totem or family sign is seen above. Apparently, they set out on an expedition lasting three days, three suns under the arches of the sky, with their magic maker, the man on horseback, to bring success. The turtles shows that the foray was successful, owing to the bravery, indicated by the eagle, of the Indians. Whether the meaning of the curious creatures at the bottom is a panther, the totem of the chief, or a snake, to show that no one was killed or whether they are animal spirits invited to aid the expedition, is rather obscure.

TOTEM POLE. This well-known pictorial way of conveying a meaning, allied to pictures on tombstones and tattooing on the body, indicated certain features of the clan or family of an individual. They were erected in front of dwelling places and were found in British Columbia, Central America and New Zealand, the totem itself becoming the chief's signature in dealings with other people. The one in the picture, from Queen Charlotte Island, is 38 ft. high and is now to be seen in the British Museum.

ARCHAIC HIEROGLYPHS. Pictures lead to hieroglyphics, the curious shapes and drawings that cover the walls of ancient Egyptian temples and pyramids. The shapes represented words, syllables or letters, with a picture sometimes to make the meaning clear.

The archaic hieroglyphics seen in the picture come from what is known as the Father Schid tablet, a relic

of probably the earliest form of lettering before use had begun to make the outlines more simple.

BONE RING. In China, the pictures of bygone ages are still to be seen in the writing of to-day. It is very difficult to decipher, as there is no alphabet and many words have each a number of meanings, but as with the Egyptian hieroglyphics, so the Chinese draw their picture, much simplified in shape, with others added to give the full meaning. The earliest form of Chinese writing known is seen in the picture of the bone ring. This dates probably as far back as 1700 B.C. and was a badge given by the emperor to a deserving official.

The story of letters does not end with hieroglyphics. Hundreds of years passed in which they travelled at first by the way of Phoenician traders to Greece, where they stayed for 2,000 years; then to Rome, then north to Russia, and thus throughout the world, changing in form and direction according to the needs of various peoples and the material on which they wrote.

BABYLONIAN SEAL. Besides writing, the Assyrians, Babylonians and, later, the Egyptians, printed on clay, and in the last picture is a seal on which is inscribed in three languages the name and titles of Darius the Great, King of Persia, the design showing him hunting lions in a palm plantation. A seal was made of precious stones such as onyx, amethyst, topaz, lapis-lazuli, the design being cut with a metal graver and the deeper parts hollowed out by means of a drill. On the conclusion of a treaty or a trade agreement the seal, being made in the shape of a cylinder,

could be rolled along a clay tablet and thus a permanent record was made. As the cylinder was hollow, the owner threaded it on a string as a convenient way of carrying it.

74. Story of Writing—2. (*Vol. II., p. 563.*) All the letters used up to the beginning of the Christian era were upright capitals. The minuscule or small letter developed with the transformation in the means of writing.

EGYPTIAN SCRIBE. This man is seen writing on papyrus with a reed pen. Papyrus was made from a water plant that grew by the river Nile. The stems were split and pasted together to form a page; then a further page was pasted on the top in an opposite direction and so on many times, the whole mass being heavily weighted and left to dry. When ready, a number of pages were glued together in a long strip and rolled round a decorated rod to prevent cracking and also for convenience in using. The ink, made of soot and vegetable glue, could be easily erased with a sponge though the scribe often had to use his tongue. Papyrus and ink gave much greater speed to writing and amongst ordinary people there was soon a tendency to run letters together and to curve their original straight lines. The priests wrote carefully to preserve the beauty of the old lettering, but before long three definite styles were in vogue, the old hieroglyphics chiselled in stone, the hieratic script of the sacred scribes, and the demotic or very cursive style used in commerce.

ROMAN WRITING MATERIALS. The materials shown were still employed right up to the 18th century.

They were the famous waxen tablets of the Greeks and Romans, used mainly for letters, business notes and in schools, and not for work that was expected to be lasting. Papyrus was expensive so tablets were prepared with hollow centres for the wax and holes punched in the two inner corners so that they could be fastened together. To write on the wax, a metal stylus took the place of a pen. As the wax could readily be rubbed smooth, a tablet could serve many times and no schoolboy of the period was complete without one hanging at his belt.

MONK ILLUMINATING. This is a reminder of the beautiful decoration that the monks gave to their penmanship. The writing was no longer on papyrus, but on parchment or pergament, the name given to it by the city of Pergamos in Asia. Here skilful leather workers prepared a material from the skins of sheep and goats to take the place of papyrus. When Egypt was overrun by the Arabs, the export of papyrus into Europe was stopped altogether, and in the Dark Ages when reading became almost a lost art, the result of countless years of development was kept alive only by work of the monks, chiefly of the Benedictine order. A room in the monastery, the scriptorium, was set apart for the daily toil of copying the scriptures and other literary productions. In it was the complete outfit of the writer—parchment; vellum from newborn lamb or kids; pumice stone for smoothing; pens made from reeds or from goose or crow feathers; black ink made from oak galls and copperas, and red ink made from red earth. Each book represented many tasks; one monk split the leather, another acted as polisher and

smoother, a third did the writing, a fourth the illuminating, a fifth was the artist who drew the tiny pictures, and a sixth bound the finished work into a beautiful volume. Parchment was very expensive and for economy letters were placed as close as possible to each other or run together, and shortened forms such as Jm. for Jerusalem were often used. Thus the uncial or large letter, after becoming rounded, diminished in size and little by little developed into the perfect minuscule as used to-day.

PRINTING. William Caxton is here shown displaying his first printed book, *The Dictes or sayengis of the Philosophers*, to King Edward IV in the year 1477. The art of printing followed on progress in paper making. The Chinese, 2,000 years ago, made paper from bamboo, grass and old rags, but it was not until the 15th century that mills for its manufacture were set up in Europe. Paper was very much cheaper than parchment and consequently all types of intelligent people, other than monks, could learn to write and read.

In the days of William the Conqueror, stamps and seals, similar to those of the Babylonians in purpose, had been fashioned by engraving on wood. These in turn gave the idea of carving on a block, a complete page of a book, so that many prints could be taken, and in the 14th and 15th centuries block books, as they were called, were quite common in Germany and Flanders. This was very laborious work, and at last separate movable letters, or type, were invented, either by Johann Gutenberg, 1398 to 1468, a printer from Mainz, in Germany, or by Lourens Coster, who

printed at Haërlem, Holland, between the years 1440 and 1446. Whoever it was, the great gift was given to the world, and when metal type took the place of wooden letters, books were available for all who cared to understand. William Caxton learned the trade of printing in Bruges, where he had lived for thirty years. He introduced it into England and later, the universities of Oxford and Cambridge carried on with the work.

75. Number of Days Required for Mailing Overseas. (*Vol. I., p. 160.*) This composite chart has been devised for reference work with regard to general knowledge. The little pictures typical of various regions are interesting and stimulating to children engaged in geographical research. In dealing with the section of mathematics relating to post office work information is also given for numerous questions with regard to overseas' mails.

76. Map of London. (*Vol. VIII., p. 298.*) This map has been drawn to show the area of London of most interest to visitors. The busy heart centred upon the Bank can be seen readily and also the main arteries leading in all directions from this great hub of England. By the simple street plan, the approach is made easy to the monuments and buildings famous in history situated in an area stretching from the Tower in the east to Westminster Abbey in the west. The position of the termini of the main railway lines on both sides of the river should be noted also and the bridges, both road and rail, connecting the city with the southern counties.

77. Map of Edinburgh. (*Vol. VI., p. 501.*) This map helps considerably in appreciating the reason for Edinburgh's claim as the modern Athens. The Castle Rock is no mean substitute for the Acropolis, and the Calton Hill offers a remarkable similarity to Lycabettus.

From the plan of the streets, the position of the congested Old Town, "Auld Reekie," with its towering tenements and malodorous "wynds" or byways, stretching between the Castle and Holyrood Palace is very noticeable when compared with the orderly layout and spacious roads of the New Town lying west of the Calton Hill and on the far side of the North Loch, (drained to receive the North British Railway).

Places of historical interest can be readily observed, including St. Giles Cathedral, the Grassmarket, the Cowgate, the Tolbooth and John Knox's house. In the modern city, Princes Street, famous for its notable monuments and public buildings, is the most famous thoroughfare. A note should be made also of the two great railway stations and the numerous buildings of educational interest which exemplify the intellectual repute of the City.

78. Geographical Regions—Tundra. (*Vol. VI., p. 250.*) Various aspects of life in the tundra.

SPRING SCENE. During the spring and short summer the ground is covered with mosses, lichen and innumerable small flowering plants. Birds and animals are numerous and flocks of eider-duck, ptarmigan and cranes are to be seen flying to their nesting grounds in the north. The inhabitants live in skin tents, two of which are shown pitched near to the river. The presence

of fairly large trees indicates that the part depicted is close to the coniferous forest belt.

ESKIMOS. An Eskimo family with the typical "igloo," or permanent winter dwelling, in the background. Their clothing is made of furs, and is loosely shaped to the figure. Note the hood-like cap necessary in severe weather, and its use for carrying the baby. Modern implements are now used in many regions where the Eskimo is in contact with the white man.

HERDING REINDEER. Another summer scene typical of Europe and Asia. A herd of partially domesticated reindeer is shown. The Tundra tribes allow such herds to roam in semi-freedom, and follow them round the various feeding grounds. In winter the reindeer get their food (moss, etc.) by digging through the snow with their forefeet.

79. Geographical Regions—Coniferous Forest. (*Vol. VI.*, p. 254.) The life and industries of people dwelling in cold forested regions. Below, a map shows the distribution of the coniferous forests.

TYPICAL SCENE IN NORWAY. Part of a fiord with its steep forested slopes, rising abruptly from the water. Note the waterfalls and the small patch of alluvial lowland on the left hand side of the picture. A hydro-electric plant is shown with pipes leading the water down the fiord side. The mountain peaks are rugged and are in strong contrast to the comparatively smooth slopes of the fiord caused by glacial action.

AMERICAN INDIANS. Note the tepees. These consist of a number of poles placed in a circle with their upper ends crossing each other. Round them is stretched a decorated skin cover. When the tents are struck the poles are fastened to the backs of the horses, one end, being allowed to trail along the ground. Note also the picturesque costumes. After a great decrease in numbers, the N.A. Indians in reservations appear to be gradually recovering.

LUMBERING IN CANADA. The picture shows part of a lumber-camp; logs are being lifted by means of pulleys to the truck, on which they are transported to the nearest river or direct to the saw-mill. Overhead transport is often used for conveyance to nearest flumes.

PULP AND PAPER MILL. This picture gives some idea of the type of machinery used in a modern paper factory. The machines are capable of turning out more than 500 feet of paper per minute. This is shown being wound on spools into rolls three or four feet in diameter. Water-power is the chief source of power in such mills.

FUR TRAPPER. A trapper setting out from a settlement into the forest with his sledge containing the boxes in which the furs will be packed. Such trappers are sometimes away for months at a time, and the chief furs obtained are those of the sable, ermine, mink, muskrat, fox, martin and beaver.

80. Geographical Regions.—Cool Temperate Deciduous Forest. (*Vol. VI., p. 256.*) Varied types of

industry carried on in this region. Note in the map below these forests are more unevenly distributed throughout the world than the coniferous belt.

ENGLISH PARK LAND. A scene such as this is typical of a country estate in the south-east scarplands of England. Much of the original timber has been removed to satisfy needs of higher civilization.

DAIRY FARMING IN DENMARK. Denmark specializes in the production of bacon and milk. Pigs are reared scientifically, and we see some being fed on skim milk which has probably been returned that day from a co-operative creamery.

ORCHARDS IN THE LAKE PENINSULA OF CANADA. Apples are the chief fruit grown in this region where they "attain a perfection unsurpassed in any other area." Other fruits grown in this region include pears, plums and cherries

IRON AND STEEL WORKS. Part of the interior of a large iron and steel works showing the molten steel being poured into a huge container. This picture indicates the industrialisation that is typical of this region throughout the world.

SALMON FISHING IN BRITISH COLUMBIA. The huge drag seine or net is stretched across the narrow river, and the salmon are caught in it as they go up-stream. Here a drag seine is being hauled in. Note the mixed coniferous and deciduous forest.

81. Geographical Regions—Warm Temperate Deciduous Forest. (*Vol. VI., p. 257.*) Industries in temperate areas nearer the tropics.

SILKWORM CULTIVATION IN CHINA.

The trays, upon which the voracious silkworms are kept in the homes of the peasantry, are notable in this picture. Women and children bring in fresh mulberry leaves every day, keep the trays clean and see that the temperature and humidity of the room are constant. After several weeks, when the "worms" are fully grown, they are placed in straw beds. There they spin cocoons which the women pick out by hand. On the right of the picture a girl is shown winding off the silk from the cocoons by means of a bamboo wheel.

CHINESE FARMERS. The lowlands of the Hwang-ho and Yangtze-kiang were, by nature, forested, but have been cleared to make way for an intensive form of agriculture. The methods employed in farming are still quite primitive, and the wooden ox-drawn plough is typical of many parts. The farmers are too poor and the plots of land too small for the introduction of modern implements.

COTTON PICKING IN THE U.S.A. Note that the plants occur thickly in rows, and that the picking is done by hand owing to irregularity in ripening. When the cotton is ripe the "boll" bursts exposing a bunch of white fibre. Negro labour is largely employed; note the bags hanging from the labourers' waists. When these bags are full of lint they are emptied into baskets which are then transported in waggons to the

factory (shown to the left of the picture). Here the fibre is separated from the seed by the process known as ginning.

GATHERING PINEAPPLES IN FLORIDA. An extensive pineapple plantation in Florida. The factory is shown in the background where the pineapples are graded for export—whole or canned with sugar syrup. The tough, spiked leaves of the plant are an indication of the heat and dryness of the summer season.

82. Geographical Regions—Mediterranean Type. (*Vol. VI., p. 260.*) The Mediterranean type of climate occurs in numerous areas in the world as indicated on the map. Winter rains and summer draught are responsible for the peculiar vegetation.

VIEW OF CRETE. This picture illustrates the rather barren nature of parts of the Cretan coastline. Goats are typical animals of the Mediterranean, whilst evergreen trees and shrubs can be seen on the hillsides. Note the prickly-pear in the foreground.

FARMING IN SOUTHERN ITALY. A settlement on a ridge terraced for the cultivation of vines. The terrace faces south. Evergreen trees and shrubs are to be seen over the area surrounding the ridge, whilst in the foreground part of the hill-slope is being ploughed, in preparation for the sowing of hard "macaroni" wheat.

VINEYARD IN CALIFORNIA. A typical plantation of the San Joaquin Valley of California. The

vines are pruned and are not allowed to grow higher than 4 ft. Most of the grapes are dried and exported as currants and raisins.

THE ACROPOLIS. This is an isolated hill rising over 500 feet above the surrounding plain. It is made of hard rock which has withstood weathering, and was the original settlement around which Athens grew up. The Parthenon, on the summit, still stands as a monument of the days when Greek civilisation was at its zenith. Early civilisation is a sign of the fertility of Mediterranean lands.

83. Geographical Regions—Temperate Grassland.
(Vol. VI., p. 264).

KHIRGHIZ HORSEMEN. A summer scene on the Asiatic steppes. In the background is an "aul", or collection of yurts. Note the circular shape of the yurts. These portable dwellings vary from 12 to 20 feet in diameter, and are made by wrapping large pieces of felt round a collapsible framework of poles. The poles are made from willows and other trees which are found only along river banks. In the foreground is a scene typical of the herding occupations of these peoples. Note the vast stretch of undulating grassland.

WHEAT PRAIRIES. The picture shows two large tractor-drawn combine harvesters, which both cut and thresh the grain. The straw is forced out into piles which are burnt later on. Note the size of the fields and the vast expanse of level land. In a number of places there is a tendency for smaller and mixed farms owing to the loss of fertility in the soil.

CATTLE ON THE PAMPAS. Here we see two gauchos (cowboys) rounding up a herd of cattle on one of the great 'estancias' in the Pampas. These estancias sometimes cover an area of over fifty thousand acres, and are often made up of "fields" with an area of over a thousand acres. The farm labourers are known as peons.

SHEEP FARMING ON THE MURRAY-DARLING LOWLANDS. The picture shows a "round-up" of a flock of sheep. Most of the sheep of this region are merinos, bred for their wool rather than for mutton. This is partly because the rainfall is low and partly because in the early days there was no refrigerator system for meat transport.

MEAT FACTORY IN THE ARGENTINE. A modern meat packing factory is shown with the stockyards in the foreground. The animals enter the factory through a gate, beyond which they are killed. The carcasses pass on trolleys by rows of men, each of whom has a particular operation to perform. All the various parts of the animal are used, and it is estimated that there are roughly 100 inedible products besides the meat products of the packing house. The latter go out as either fresh, pickled or canned meat, and meat juices.

84. Geographical Regions—Hot Deserts. (*Vol. VI., p. 269.*)

CAMEL CARAVAN. A sandy region of the Sahara with a small camel caravan, still the best form of transport across trackless wastes. The dunes, constantly

changing in appearance are in places 600 ft. high. Note the armed guard.

OASIS. A typical small oasis in the Sahara with the characteristic date-palms and other cultivated crops, such as maize, melons and oranges. Note the village with its mosque and flat-roofed houses.

GOLDFIELD IN WESTERN AUSTRALIA. The surface equipment of a gold-mine at a centre such as Kalgoorlie in Western Australia. Note (right background) the "dump" made of the soil thrown out during the excavation of the mine. Water from the region around Perth is carried 300 miles in pipes for use in irrigation, gold-extraction, and in the homes of the people.

NITRATE FIELDS. ATACAMA DESERT. Chile has a virtual monopoly of the commercial production of nitrates, which being soluble, only accumulate in deserts. The mineral is easy to obtain; surface deposits are first removed and then the nitrate is broken up, shovelled into lorries, carts or railway trucks, and taken to the works (shown in the background), where it is dissolved and recrystallised. Several by-products, the most important of which is iodine, are extracted in the works. As in Western Australia, water is piped into the nitrate districts, the sources of supply in this case being in the Andes.

AERIAL VIEW OF DESERT TOWN. Note the wall surrounding the town, the flat roofs and the way in which the houses are built around a quadrangle

with the windows facing inwards. A door is often the only break in the outer wall. This is to make defence against desert raiders easier.

85. Geographical Regions—Savannah. (*Vol. VI., p. 275.*)

EAST AFRICA. The natural vegetation is grassland (in parts very tall) with occasional trees, especially near rivers. Animals such as the lion, antelope, zebra, gazelle and giraffe inhabit the African savannahs. Pests are the tsetse fly and "white" ant.

NATIVE VILLAGE IN EAST AFRICA. Note the "boma," defence against wild animals. The conical roofs of the huts are resistant to sudden storms.

TOBACCO CULTIVATION. N. RHODESIA. The size of the leaves and the plants is noteworthy. The factory where the tobacco is cured is shown in the background. Mules are valuable transport animals in difficult country, being surer-footed and hardier than horses though lacking the strength.

COLLECTING GUM-ARABIC. The gum-acacia tree native to the desert borders is cultivated in many parts. Gumming is caused by excessive dryness of the atmosphere or produced artificially. The liquid oozes but dries hard, and is plucked from the tree by the native collectors. The Anglo-Egyptian Sudan exports a large amount of gum-arabic.

EUROPEAN TYPE OF TOWN IN EAST AFRICA. This picture is typical of any large town

in East Africa. It illustrates the remarkable modernisation that has followed the advance of the white man. Roads, transport, houses and planning compare favourably with the best European improvements.

86. Geographical Regions—Tropical Monsoon. (*Vol. VI., p. 281.*)

GANGES PLAIN. A representation of the flat, middle Ganges plain with the Himalayas and their foothills rising abruptly in the distance. These mountains form a sharp northern boundary to the tropical monsoon region. Note that the land is largely cleared for cultivation. Methods are still very crude; note, characteristic oxen for draught purposes and the clumsy waggon. The communal well is typical of village life.

RIVER SCENE IN CHINA. Population is concentrated in the large alluvial lowlands of China, and in many parts "overflows" on to the rivers where the people live in boats. Typical Chinese sampans and junks are shown lying alongside the wharves. Note the small boat carrying the cormorants used for fishing.

RICE CULTIVATION IN CHINA. The planting-out process. The swampy land has been prepared previously by ploughing, and the surface consists of liquid-mud obtained by irrigation ditches. Note that the young plants are planted out by hand, a laborious process which demands a large and cheap labour supply. During the early stages of growth the land is kept under water, although this has to be frequently drawn off so that weeding may take place.

Furthermore the water must not be allowed to become stagnant.

TEA PICKING IN ASSAM. In Assam, tea is grown on the hills sloping down from the Tibetan plateau. The shrubs are planted in rows about four feet apart and the picking is done largely by women owing to the delicate nature of the work. The long baskets are characteristic of the plantation. At the factory the leaves undergo many processes of preparation now largely carried out by machines.

ELEPHANTS IN BURMA. Teak is one of the most valuable types of timber found in tropical monsoon regions. Elephants are employed to pile the teak beside streams down which the logs are to be floated in the rainy season, and also to drag the great trunks through the forests. They are more suitable for the work than tractors because (a) teak trees are few and far between; (b) much of the land is marshy; (c) little cost in upkeep: elephants feed on forest vegetation.

87. Geographical Regions—Equatorial Forest. (*Vol. VI., p. 287.*)

SCENE ON THE AMAZON—Congo Pygmies. The luxuriance of plant life in these regions—the large trees struggling to push their way through to the light and air above the forest canopy. Note the creepers hanging from the trunks and branches and the tremendous variety in the undergrowth that flourishes wherever light can penetrate. Where the forest canopy is very thick the lack of light and air precludes the existence of undergrowth. The pygmies are noticeably

short in stature, being rarely more than four feet high. They wear practically no clothing or trouble to ornament themselves. Their chief weapons are poisoned arrows which are shot from bows or blow-pipes. Some "shifting" cultivation is carried on by the tribes.

RUBBER COLLECTING IN MALAYA. A modern rubber plantation as opposed to the collection of wild rubber, now dying out. Note how the trees are set in cleared ground in rows, usually about twelve feet apart. The trees are about twenty inches across. The labourers are Chinese and other Asiatics and are generally imported to serve on the plantations for a period of three years. Those engaged in the collection of latex cut gashes in the trees in a systematic manner and put cups beneath to catch the liquid which oozes out. This liquid is placed in the large drum and taken to the plantation factory. The actual cutting is generally done before midday in order to avoid the heavy afternoon rainfall.

GATHERING BANANAS. Part of a banana plantation on the wet coastal lowlands of Central America. The tree-like plants have large deep-green leaves and are between six and ten feet high. Each tree produces one bunch on which there are between 100 and 150 bananas. The main stalk is also cut and young shoots grow up from the old stool to replace it.

GATHERING COCOA PODS. The cocoa pods hang from the trunk and main branches of the tree. They are between 6 and 12 in. long and contain about 70 beans embedded in pulp. In the background is a

pile of pods which are being slit open by natives, who empty the beans into baskets ready for transport to the "sweating" house where they are fermented. The cocoa trees are between 15 and 30 feet high, and are planted at regular intervals. When the trees are young, the shade necessary for their protection against direct tropical heat is obtained by growing them under the branches of leafy trees, such as bananas.

88. Tree of Animal Life. (*Vol. II., p. 80*). An interesting method of classifying animals, tracing their descent from a common form. This is more approachable for children who cannot appreciate a tabulated arrangement. Some of the groups have been omitted to save confusion.

The phyla (primary groups) starting from the base of the tree are as follows:—

PROTOZOA. Unicellular animals sometimes called non-cellular in that they differ from the many-celled animals as a whole. The lowest known form of animal. Example: amoeba.

SPONGES. Slightly higher form. Sometimes classified as parazoa.

COELENTERATES. Saclike animals. Coral, sea anemones, jellyfish.

FLATWORMS. Includes many parasites such as tapeworms.

ECHINODERMS. Spiny skins. Sea urchins and starfish belong to these.

ANNULATES. Ringed creatures. Bodies divided into segments as earthworms, leeches and many sea worms.

ARTHROPODS. Jointed feet. These fall into four separate classes.

1. *Crustacea* (hard skin), e.g., crab, shrimp, wood-louse.
2. *Myriapods* (myriad feet), e.g., centipedes, and millipedes.
3. *Insects* (3 parts, three pairs legs, usually winged), e.g., cockroach.
4. *Arachnids* or spiders.

MOLLUSCS. Soft bodied. Called shellfish, e.g., cockle, cuttle-fish, snail.

CHORDATES. These are animals belonging to the sub-phylum vertebrates. The principal nervous system is dorsal in position and is generally enclosed in a gristly or bony skeleton (vertebrae). The main classes are:—

PISCES. Fishes. Breathe by gills. Swim by paired fins (considered forerunners of legs) and unpaired fins. Examples: herring, shark.

AMPHIBIA. Early life as larvae swimming by tail fin and breathing by gills. Adults breath atmospheric air by lungs and move by legs. Some forms (salamander), far from water, are viviparous.

REPTILES. Breathe atmospheric air by lungs. Scaly skins; lay eggs. Creep with or without short legs.

This class, many orders now extinct, at its height in mesozoic period. Examples: snake, tortoise, crocodile.

MAMMALS. Young developed in body of mother and suckled with milk. Furry or hairy covering. Example: cat.

There are numerous orders belonging to the last-named class, such as, *carnivores* (flesh-eaters), e.g., lion, dog, bear, weasel, otter, seal, walrus, each representing a different family; the *insectivores* (insect-eaters), small animals with fine teeth, e.g., mole and shrew; *rodents* (gnawing) e.g., mouse, rabbit, squirrel; *primates*.

Most of the primates are adapted for tree life—opposable thumb allows grip and collar-bone well developed to take weight when hanging. Teeth and food canal adapted for mixed diet. Brain well developed, flat nails, gregarious habit. Man, the highest representative of the order.

89. Geographical Chart—Cotton Production. (*Vol. VIII.*, p. 488). The main facts regarding production and distribution of cotton, the world's most important vegetable fibre.

From the map notice should be taken of the distribution of the crop throughout the world, generally speaking, between latitudes 43° N. and 33° S. of the Equator. The main shipping line between New Orleans and Liverpool only is shown as an indication of the American upland type of cotton that is most suitable for English mills. Asiatic cottons are mostly short stapled, that is with fibres from $\frac{3}{8}$ to 1 in. in length and produce coarser cloths required mostly by native peoples. The long, soft Egyptian cotton, excellent for

mercerising and the best quality materials is also noteworthy, though the amount of ground available for cultivation is restricted.

Type of soil is not the most important factor in cotton growing though insufficient drainage results in rank foliage and poverty of flowers. A study of the graphs will show, however, the necessity for warmth or even heat and a water supply greatly in advance of that in England. In America the growing period is from June to mid August; from then to October, hot, dryish weather is needed for the continuous pickings. Frost kills the plants which in most countries for the best results are treated as annuals. A note should be made of the need for irrigation in European countries, Egypt and other regions.

The composite picture at the bottom of the chart shows the main stages in transport from plantation to mill. Although native hand-picking is still general, harvesting machines have been devised in the U.S.A. in order to reduce costs. British Empire cotton (Sudan, Uganda, Nigeria) is mostly pressed (35 lb. to a cubic foot) in bales of 400 lb. weight covered with bagging; the Egyptian bale weighs 750 lb. and the American farmers', 480 lb.

Interesting items from the botanical point of view are the flowers, yellow, white or red, according to the variety, and the relationship of the plant to the wild mallows of the English countryside and the hollyhocks of the garden.

90. Geographical Chart—Wheat Production. (*Vol. VIII., p. 489*). The main conditions for production, the world distribution and the sources of supply to

the United Kingdom, of wheat. A great amount of information can be gathered from the chart by the observant child and at the same time opportunities are offered for research or for work in free activity periods.

He should note by the great range of climatic conditions under which wheat flourishes, the adaptability of the cereal and find out the connecting link that permits production, in both rainy and rainless regions, mild and extreme, and monsoon India. The apparently scanty yield of the southern hemisphere also opens a further field of inquiry. By the graph he can discover why spring sowing only is possible in Canada and compare his conclusion with the reason for autumn sowing in England. The rainfall diagram offers further help and a comparison of the two establishes the important fact that the minimum period of 90 days is necessary for full growth.

Other objects to note are the means of temporary storage at dock sides and the elevators for transferring the grain loose into the holds of ships with the least effort and waste of time. The great sea highways shewn on the map can afford great interest. Connecting links, ports of call, coaling stations, steamship lines, types of ships and cargoes, crossing the line, all offer abundant and varied forms of activity for the child.

91. Geographical Chart—Maize Production. (*Vol. VIII., p. 490*). This chart affords a detailed study of the rapidly increasing importance of this cereal. Firstly, the child should notice the sources of the bulk of the world's supply and also the numerous regions where lesser quantities are grown. This could lead to a consideration of peoples and types of land affected.

He might next observe how far north production ceases and the great land masses where maize is unobtainable. Reference to the charts will provide answers to his questions. Chicago, the corn centre of the U.S.A., provides a sub-tropical temperature for 150 days, the necessary growing period, and also a mean summer heat of over 66° F. for ripening. The rainfall, too, shows a regular fall in summer of over 8 inches, another requirement. On comparison with the corresponding graphs for London it will be seen that maize will not come to full development in England.

From the map, the few shipping routes can lead to questions regarding difficulties of transport, and the many uses of maize in special regions that cause home consumption to equal the production. Items to note in the picture are the cover needed to protect the grain from dampness in harvest time, the sacking for transportation, the use of Negro labour, the cranes at the dockside instead of elevators and chutes and in the distance the Tower Bridge, the final destination in Great Britain.

92. Geographical Chart—Oats Production. (*Vol. VIII., p. 491.*) This Class Picture shows at a glance the extraordinary importance of this grain in the countries of the north temperate zone. It is the second of the world's cereal crops and though in ground it covers but half the acreage devoted to wheat, in the actual bulk harvested it is not a great deal short of that valuable foodstuff.

The map shows the very hardy nature of the grain. It flourishes in the bleak and wet places that are quite unsuited to wheat, though beyond 70° N. Lat. the temperature is too low. The sub-tropical climate

required by maize is useless to oats and also conditions where warmth and dryness prevail together.

A study of the charts will tell why the U.S.S.R. is the world's greatest grower. Sowing in late April affords an ample growing season for three months followed by a short warm period for harvesting. There is also plentiful rainfall. In our country the charts indicate good wheat conditions, but in the west where there is too much rain and in Scotland where the temperature is also too low, oats flourish exceedingly. It will also be noticed that the wetter states of the U.S.A. are great oats growers and also the regions of poor soil in France and Germany.

In the picture are familiar scenes from the oats country and a busy dockside with the grain already sacked waiting to be lowered by a crane into a ship's hold. The milling by which the rolled oats for porridge and the meal for cakes and biscuits is obtained, is usually performed at the port of Landing. It should be noted that all the oats imported into England come from America.

93. Geographical Chart—Rice Production. (*Vol. VIII., p. 492.*) Rice is the staple food of southern and eastern Asia. From the preceding charts the children now understand that each cereal demands its own particular climate and soil. They might give reasons why certain regions are unsuitable for these grains; e.g., there is too much or too little rain, rain does not fall at the right season and the season for growth is too short or too cool. This map shows the cultivated areas to be regions mainly of great heat and heavy rainfall. River valleys or deltas can be associated in each case and

the conclusion will be that rice is a grain peculiarly fitted for hot, swampy lands. It may be noticed that in certain countries, northern Italy for example, climatic conditions are not the same as those along the river Ganges although rice is shewn as a product. This could lead to talks on the importance of the grain causing the use of irrigation in order to provide the water necessary for the development of the plant.

The graphs indicate very clearly the great heat and torrential rains such as are brought by the S.W. monsoon that together make the Ganges valley ideal for rice cultivation. A temperature of from 60° to 80° F., is necessary during the growing period and a minimum of 50 ins. of water during the year. The enormous quantity grown in China and in India show not only the great productiveness of the plant, 70 bushels to the acre, but also the density of the population dependant upon it. In proportion to this huge supply, little is imported into England as wheat is the main bread food of western peoples.

In the picture, the primitive methods of the native farmer that still exist, can be seen. The use of the water buffalo for field work, the rude waggon, the palm trees and the employment of native labour for loading the ship all indicate the character of the rice producing region. An interesting point is the suggestion of the Taj Mahal in the distance.

94. The Line of a Vase. (*Vol. V., p. 424*). This Plate illustrates how children can make a simple curve for a vase. Suppose we wish our vase to be 6 in. high. An opening at the top 2 in. across will be about right for the bunches of flowers. What size shall we make

the vase at the bottom? Our first aim is to keep things simple, therefore, we do not want to add another size if we can avoid it, so we will try making the bottom and top the same size, 2 in. That gives us a simple framework on which to draw our vase. Notice that two is a third of six, so that our sizes are already definitely related.

The first picture shows the framework of pencil lines. Now draw curves which join the top and bottom points on either side, like Fig. 1. If compasses are used to draw the curves, the point of the compass would be on the centre line that goes across the page.

Now let us try another shape on the framework. With compasses extended to $1\frac{1}{2}$ in. move the point on the upright middle line until the radius touches the top corners A and B, and draw parts of a circle on each side. With a straight edge draw lines joining these radii with points at the bottom. Fig. 2 is exactly the same as Fig. 3, only the curves are at the top instead of at the bottom. For Figs. 4 and 5 we have only put convex curves in place of the straight lines; and for Fig. 6 draw concave curves. Fig. 6, when turned up the other way, shows a conventional Oriental shape. All these shapes should be cut out in paper by the children.

Measurements are given to ensure some sort of uniformity. Let the children draw the curves and shapes by eye alone. Teach them to use the scissors for cutting and their hands for modelling. Encourage them to make large curves with the arm at full length, using the shoulder as a radius. Pivot at the elbow and wrist to make smaller curves.

95. Proportion. (*Vol. V.*, p. 426). The curved sides of the vase shapes which are here shown down the left-hand side of the Plate are exactly the same shapes that were drawn for the last Class Picture only here they are reduced in size.

It is important to realise that directly the general proportion is altered it is necessary to alter the curves to suit the new proportion.

Let us take the first three shapes. Suppose it is decided to make vessels more square in general proportion. The former vases were all 6 in. in height. We draw exactly the same curves with more material between them, until we have shapes 6 in. wide as well as high. The result is seen in the three middle examples, 2A, 4A, 6A. They look rather dull, heavy, cumbersome shapes. We feel immediately the need for rounder, fuller and more generous curves in order to get more feeling of life into the shapes. The examples shown to the right of these—2B, 4B, 6B,—show something of the sort of curves and shapes at which we should aim. In these we have necessarily had to reduce the size of the base and also the opening in the top of each vase, but our shapes have ample stability and sufficiently wide mouths, so we find that with *more* material and squarer shapes, we must use fuller and more generous curves.

Let us see what happens if we use *less* material, as shown in the diagrams at the foot of the Plate.

We have only to draw the original curves (as in Figs. 5 and 6) closer together to make a vase half the width of these, to find that the shapes have not sufficient base on which to stand safely, or sufficiently wide necks in which to put anything. In any case, it becomes

obvious that for a tall slender vessel we need much flatter curves, thus making it more graceful and elegant, slimmer in fact, something like 5B and 6B. With 6B, too, we should probably add a rim to enlarge the base to allow the vase to stand safely. So we find that our feelings about the mass or general proportion dictate what sort of curves we use.

There is one proportion which is generally accepted nowadays and has existed and been in use for centuries. It is known by several names and is referred to as the Golden Rod, the Golden Rule, the Golden Measure, or the Divine Proportion. To give a rough idea of it, take a stick or strip of paper 8 in. long; mark off 3 in. from one end so that the other end is 5 in. long. This proportion of 3 to 5 represents the Golden Rod.

Much of our furniture and interior decoration use this principle. An excellent example occurs in some ladder-back chairs where the spaces between the back slats decrease in depth as they go upward, Fig. 7.

In most chest of drawers all the drawers are not made of the same depth. The bottom drawer is deepest and those above graduate in depth with the shallowest at the top. The tallboy chest of drawers (Fig. 9) shows this clearly. It not only makes differently shaped receptacles for various kinds of articles, but is such an arrangement of shapes and proportions that is pleasing to the eye—in fact, it is a handsome piece of furniture.

96. Japanese Prints. (*Vol. V., p. 428*) In the top corner picture of two girls gathering shellfish, the setting or background for the two figures is simply grey and blue—the ordinary colours of the seashore

eminently suited to and expressive of the girls' quiet occupation. From this very peaceful, quiet picture, pass to the central one which has yellow and gold in sharp contrast to black. This is a portrait of an actor playing the part of the heroine (for in Japan the women's parts were always played by men). The colour at once shows that the real subject is nobility and tragedy.

No. 3 is again a quiet scene from a series on silkworm culture. It shows a girl spinning the silk from the cocoon and another talking to her. It is a more domestic scene than that of the first picture and consequently is painted in a warmer colour scheme.

Below these are two landscapes by Hiroshige (pronounced Hero-she-jee, soft *j*) who was one of the world's greatest landscape painters. Along the top and bottom of each of these scenes there is a sudden gradation into deep colour. This is so contrary to our Western ideas that we wonder what it means and what it does. Let us take the left-hand view first—a yellow sky gradating into grey to black. The black is menacing but the yellow is cheerful and reassuring. It means a *passing shower*. The descending lines across the sky suggest the first falling drops of rain, while the people crossing the bridge hurry for shelter.

The artist knows that the sky is not so black in nature, but he feels justified in a slight exaggeration—for with the Oriental, each picture is a dramatisation of expression.

This gradation at the top and bottom of the picture is used to influence the beholder in several ways:

1. It sets the mood of the picture—menacing, but ultimately reassuring.

2. It suggests the dome of the sky.
3. It serves to make a balance of darks throughout the picture.
4. The exaggeration in depth of colour puts the landscape part back in its proper place and gives distance and perspective.
5. It serves to call our attention to the full limits, from top to bottom of our picture space.
6. The small upright river scene in moonlight shows the gradations used to express depth and surface of water.

So we find that a simple device which at first sight looked strange and unusual has at least half a dozen different meanings for us.

97. Decoration of China and Earthenware. (*Vol. V., p. 430.*) Naturalistic bunches or sprays of flowers for the decoration of china-ware still survive from Victorian times. Naturalistic roses, violets, pansies, lilies, etc., are all out of place on any kind of pottery. Flowers are used as decoration because of their colour, but they should be formalised and not made to look real.

This Class Picture illustrates some good examples of decoration. Here we notice how simple the patterns are—this is because the shapes of the articles are good, so that there is no need for a great deal of fancy work. For instance, on two of the dinner services, Nos. 3 and 4, there is no decoration beyond a slight ribbing, and even this is not an added pattern but something which occurs during the manufacture of the article. Each style is in a self-colour—No. 3 is a beautiful deep golden yellow; No. 4 has a cream or pale yellow glaze. You

would have to look closely at No. 3 to notice the ribs or grooves indented round each piece of the set, for this is decoration at its very slightest, depending entirely on shape and colour for its effect.

In No. 4 the slightly scalloped lines running round each article are broad and sufficiently marked to divide the larger spaces and to follow and accentuate the main lines.

On No. 1, a tea service, a gold line runs round the outside edge of each piece, while another gold line runs round the inner edge of the rim of the plate and at a similar distance on each of the other pieces. Just inside the edge each piece has a continuous line of loops suggesting leaves formed by tiny brush strokes of bright green. This simple decoration of gold and green on the white background is most effective.

No. 5, a breakfast, dinner and tea service, has four lines alternately gold and green running at equal distances round the rim of each piece.

No. 6 is equally simple, but requires more detailed description and explanation. Just within the outer edge of each piece is a line made up of arched brush strokes inside which are four lines of dots. The purpose of the dots is to relieve the monotony of an otherwise flat surface.

The small centre decoration, in bright colour, gives a note of gaiety, at the same time illustrating the important fact that flowers should be formal rather than realistic in design—it is impossible to tell what flowers they are since they are merely spots of colour well arranged. It should be noticed that this central *motif* necessitates a side handle on the lid of the vegetable dish.

Example No. 2 on the Class Picture is a delightful little tea-set on a tray. With its evenly distributed spots of colour, the decoration, while producing an air of brightness and gaiety, breaks up and hides or camouflages the shapes. Each example on the Class Picture suggests some particular mood—each set has a character of its own. Service No. 1 is refined; No. 3 is homely and comfortable; No. 4 is simple and dignified; No. 5 is clean and healthy, while No. 6 is pleasant and somewhat select.

98. Cups and Saucers. (*Vol. V., p. 432.*) On the examples of cups and saucers, all decoration has been cleared so that the shapes can be examined. It will be seen at once that there are not more than half a dozen distinct shapes, but infinite variations on these shapes can be seen everywhere.

No. 2 in the centre top is the most ordinary and commonplace shape.

Nos. 1 and 3 are scalloped like shells, but in No. 1 the scalloping is both outside and inside, and the lines conflict and disturb. In No. 3 the scalloping is on a larger scale and seems to distort the outline shape. Both Nos. 1 and 3 are single curve shapes.

Nos. 4, 5 and 6 are what we may call double bulge curves, which do not, in themselves, give a pleasing or satisfactory line.

No. 7 was taken from a Chinese egg-shell porcelain example. This is a very appropriate and simple shape, which is quite pleasing.

Nos. 8 and 9 have a slight outward flair and a definite stand at the base which gives more stability. Nos. 10, 11 and 12 are double curves, concave and convex.

Nos. 10 and 11 have the concave curve above which gives a slight flair to the edge.

There is little variation in the saucers. Within narrow limits, the diameter alters slightly in proportion to the cup. The saucer also has the general shape and curve of the cup, and is sometimes deeper or shallower to give better proportion.

Now let us look at the handles. On No. 3 is a dotted line in a half circle running from one end of the saucer over the cup, to the other end of the saucer. The handle is, and should be, in such a position that it lies comfortably within that half circle. There it projects least and will stand less chance of being knocked or broken. Also it will be found as the best balanced position for holding, whether the cup is full or empty.

The feel of the handle is quite as important as its shape. No. 1 has a handle that is twisted and which reminds us of rope or string. This is surely an unfortunate suggestion in a part which demands stability. No. 2 handle is supposed to be stronger, which is doubtful, and the shape is not pleasing.

Several of the other examples have projections. For instance, by comparing the handle of No. 8 with that of No. 9, it can be seen that the projection is quite unnecessary. It would obviously catch in things and get broken off. No. 10 is a bad handle; it projects too much, is ugly in shape and appears insecurely attached.

Having considered the chief features of these cups and saucers, we notice that in each case it is simplicity which counts most.

99. Teapots and Coffee Pots. (*Vol. V., p. 434.*)

Nos. 1, 2, 3 and 5 are of metal, the first three being

coffee pots and the last a teapot. Notice the distinctive shapes of the coffee pots, for as both teapot and coffee pot may appear together on the breakfast table, there must be no danger of being unable to tell which is which. Roughly, one is tall and slender, and the other short and round. These three silver or silver-plated coffee pots are good in general shape and proportion, but one is struck by the fact that they consist of a number of parts put together. To a certain extent this is inevitable in metal and is made more apparent by the necessity for a non-conductor of heat for the handles. Metal handles would become too hot to hold comfortably, so ebony or ebonite is sometimes used instead. The method of attaching the ebonite to the metal, however, is seldom satisfactory, and when the top part of the handle is joined to a flat collar or flange, it never appears safe, even though we may know it is quite secure. If a thing looks uncomfortable or unconvincing it should be avoided; Nos. 1 and 5 on the Plate show this point.

The tendency in design to-day is towards angularity. One result of this is that these angles make things more difficult to clean and, what is more important to our consideration of beauty, they become curious mixtures of straights and curves, such as No. 2.

No. 4 is the common brown glazed cottage teapot, but in this case there is a disparity between the spout and the handle. The handle seems much too slender to support the weight.

No. 8 is quite consistent in shape and design, and is evidently not intended for a large tea-party, for it would hold sufficient tea for two people only.

No. 7 looks more like a bathroom or dental surgery

fitting than something to grace a tea-table, while No. 9 allows no space for fingers and we doubt whether it would pour out properly. But although at first sight we may not like these lines, it is on this pattern that the teapot, to suit modern needs and conditions, must develop.

The last three examples on the Plate are "Moorcroft Powder Blue Ware;" they are strong, well designed and shapely. Perhaps they are a trifle heavy in appearance, but the colour chosen for these articles is the one colour that will correct any heaviness. This powder blue is a very atmospheric colour and so makes things appear less near and objective; it recedes and so puts objects further away from the eye, and that has the effect of reducing solidity and weight. This is an excellent example of the way in which form can be modified by colour.

100. Glassware. (*Vol. V., p. 440.*) Ornamental and table glass is roughly speaking of two kinds—glass and crystal. These two materials are similar, but each has a separate character. Glass is much softer, and in its heated state is more plastic and flowing. Crystal is hard, perfectly clear and luminous; much more jewel-like than glass. It is adapted for cutting and polishing, so producing many refracting surfaces.

The best things are those which show off the essential qualities of the material, so in glass we should expect to find smooth bulb-like shapes and flowing lines, and the less ornament there is to distract the attention the more we shall be aware of the line and shape. With crystal we should expect heavier and more solid articles, as they must have sufficient thickness to cut into.

in design is one that appears to have been the outcome of a new invention—the radio receiver—which has spread to our furniture and utensils.

A knife handle in this style will be found at the bottom left corner of the Plate. But we are not at all sure that this knife would be comfortable to handle. On gripping the handle to cut anything, there are four sharp ridges which press into the palm of the hand. Made in metal, these sharp corners would take years to get rounded off.

On all the other handles illustrated on the Plate there is nowhere a sharp point or ridge, with the exception of the fiddle pattern spoon, No. 30, and it is for that reason that we prefer the Old English design above it, No. 29, which is a beautiful shape.

In No. 8 the curve of the blade, called pistol pattern, is repeated in the handle. A curved handle could similarly be applied with good effect to No. 5, while No. 2 could equally well have a curved blade like No. 8.

With carving knives of all kinds it is highly important that the handle should have a surface which gives a good grip. There is no particular reason why they should be exactly like the table knives. It is best to choose the things that are the safest and most comfortable for the purpose for which they are intended.

Forks were introduced from Italy in the reign of James I. Old English (No. 29), fiddle (No. 30) and rat tail (No. 31) are the simplest and most satisfactory shapes in both spoons and forks.

There are many people who believe that if articles are fashioned and made entirely for their purpose, beauty can be ignored or dispensed with; or at the most, beauty is a later addition, which does not affect

the purpose and use of the article in any way. In the centre near the top of the Plate is illustrated a small wooden spoon (No. 15) and a silver salt spoon, No. 16. These are drawn the same size as the originals, but the drawing of the silver spoon gives only a general idea and hardly makes one realise the sheer beauty of the design. The back is even finer than the front, the bowl being a delightfully worked shell-shape. The design is the work of one of our great traditional English craftsmen-silversmiths, and has his initials on the back. The wooden spoon is the kind supplied by ice cream vendors. Two tiny objects, both for a similar purpose, but what worlds apart!

There seems also to be a general idea that beauty means decoration, but beauty lies much more in line, shape and proportion.

102. Pots, Kettles and Pans. (*Vol. V., p. 436.*)

In the middle of the upper part of the Plate are illustrated two articles that have made cleaning very much easier work; No. 4 is a carpet sweeper and No. 5 an electric vacuum cleaner.

The carpet sweeper has two spiral brushes which revolve as the wheels are pushed across the carpet. The dust is brushed directly into the box, which is easily emptied. For all light work these are efficient and necessary articles.

The vacuum cleaner is a more powerful worker altogether. It thoroughly sucks the dirt out of carpets and textiles by means of a revolving fan run by a small electric motor. There are all sorts of attachments for getting into corners and sucking up the dirt from out-of-the-way places. A vacuum cleaner has become an indispensable article in a great many homes.

In a really up-to-date kitchen one sees little more than a number of cupboard doors. Everything is put away in its place. The children can prepare a list of the various articles in use in a large, modern kitchen. There are all sorts of saucepans, of varying sizes and shapes—preserving pans, fish kettles, fish fryers, stew-pans, and porringers or double saucepans for heating milk. These are made of metal—aluminium, copper or iron. Copper stewpans are used for fruit, because copper is not affected by the juice. Many saucepans and steamers are made of aluminium which is light to handle, durable, and requires less heat for cooking.

There are kettles of many sizes and shapes, kettles that whistle when they boil, quick boiling kettles, some in enamelled iron, most in aluminium and still a few made in brass or copper.

There are casserole dishes made of earthenware with their quaint stumpy handles, or having glazed covers and a flat handle at each end.

There are all sorts of bowls, pie dishes, and pudding basins; earthenware jugs of unusual shape, and jars, large and small. The big ones with lids are used for storing cereals and other food products.

There are fireproof oven-glass dishes in which to cook bread, cakes and pies, or to stew or casserole. All these are of good shape and appearance, so that they can be used both to cook the food in and to serve at table.

The children should be led to notice that there is a clear-cut division between the things used for cooking, and the articles used for serving. We look for something finer on our tables than in the kitchen; articles daintier, more elegant, and more showy. That is natural.

From a purely aesthetic point of view, we should say that there is nothing ugly about the cooking vessels and only a slight difference between them and the serving vessels. That difference is largely due to the craftsmanship and the material. It is obviously not fair to contrast the tin saucepan (machine made by mass-production methods) with silver ware produced by highly skilled craftsmen.

103. Chairs. (*Vol. V., p. 442.*) The chairs, Nos. 5, 6, 9 and 10, illustrated on the Plate, are four period chairs, each a beautiful thing in itself. No. 5 has a square character relieved by curved arms and legs, but the square shapes dominate and give decision and stability. No. 6 has similar opposition of straight lines and curves, but they are used in the reverse way. In this case the back and seat are curved and the legs, back and stretchers are in thin spindle shapes. But note how beautifully the whole chair is a balance of line and shape. The seat, being the only solid part, dominates, and its curve and saddle shape invite one to rest. What a lovely flowing curve there is from the tips of the arms round the back! The stretchers to the legs repeat the pattern of the spindles in the back. This is a splendid specimen of a tub chair.

No. 9 is consistently curved everywhere. This gives it a rather feminine appearance when compared with No. 5, in which the square is more masculine. Note also the rich brocade on both these arm chairs. At the time these chairs were made the seats and backs were embroidered by hand or else with rich woven tapestries made on a draw loom.

No. 7 is a modern copy of No. 9, but note the difference in the curves! Note, too, in the period chair how the arm supports flow into and become part of the legs, and see how little of this there is in the modern copy.

No. 11 is a modern square box shape. It is of no use to blame the craftsmen or manufacturers for these designs. They have been fashioned for utility alone, for such is the demand of certain people in this practical age. Line, form, proportion, beauty, all have been sacrificed for utility, and many homes are filled with these shapeless, uncouth chairs.

A good deal of modern furniture that may not be actually badly designed in itself is out of place and in the wrong setting in the home. The chair that looks big and cumbersome in a small room may look quite inviting in an hotel, club room or large lounge. The chromium plated tubular furniture, such as Nos. 3 and 4, is also out of place in the home. It is bright and clean, and generally gives an idea of efficiency; consequently it is suited to offices, workshops, restaurants, tea rooms, clubs and such places. The home should be as different as possible from the office or workshop, so as to bring change and variety into our daily lives.

Nos. 1 and 2 are Austrian bentwood chairs that were in fashion about thirty years ago. No. 8 is a cane chair contemporary with No. 1. It had every conceivable exaggeration of shape and proportion imaginable, and it creaked and groaned at long intervals after anyone had sat in it!

104. Tables. (*Vol. V., p. 444*). Although a table is such a simple object—just four legs and flat top—a

great deal of ingenuity has been utilised in its design and fine craftsmanship has gone to its making.

No. 1 on the Plate is not symmetrical; the legs are not upright, the drawer is on the slant and the whole article has a cant to the right. This table has been included because some people believe that irregularity is a proof of age and this is the sort of thing they look for in old furniture. It is not necessarily any kind of proof, and a thing that is twisted and distorted is uncomfortable to look at and live with; so if possible it should be put right. A piece that is of genuine antiquity does not lose by being made symmetrical. Distortion usually suggests rough usage, and that is an uncomfortable feeling, particularly when associated with age.

Nos. 4, 7 and 8 are also period pieces. No. 4 was included to show how tables could be shaped and decorated with dignity and refinement. There is one feature about its cabriole legs that should be noticed, that is, the claw and ball foot, which is shown separately at No. 5. It is an instance of the skill, care and craftsmanship shown in details. This ball and claw *motif* terminating the legs of chairs, side-boards, settees, etc., occurs in other periods after Queen Anne's time.

No. 7 is a James II side table, which means that it usually stood against a wall. It has a drawer as most of these side tables had. Compare the legs of Nos. 7, 8 and 9.

No. 9 is a plain hexagonal upright, with only four turned indentions on the centre pedestal at each end—a plain, simple-shaped leg. No. 8 is baluster turned, with the square left at the top and near the floor to make secure points for the table frame and stretcher.

The turned part breaks the surface with a number of sparkling little lights which help considerably to give a feeling of lighter construction. No. 7 with its twisted barley-sugar turning has the same effect on a larger scale. Glance from No. 7 to No. 9 and see how severe the latter looks, and how bright and sparkling No. 7 looks in comparison.

No. 8 is an old gate-legged table. As we have sat at one exactly like this for thirty years, we can guarantee it as being satisfactory in every way. Six people can sit at this table in comfort, and every evening one leaf is closed down and the table is moved so that we can see to work.

Of the more modern examples on the Class Picture, the legs of No. 9 have already been considered. The table is a simplification of the older gate-legged. There are only six legs, where the old ones had eight, and it opens out to a rather longer and narrower rectangular table with the corners cut off instead of being oval in shape.

No. 6 is a refectory table, and however modern the example may be it still has something of the air of a monastery and whispers of monks and fasts and penances. It is a stout and useful table for the modern home.

No. 2, a draw leaf table, is an elegant piece of furniture, excellent in every way, but it might mean that the chairs to go with it would also need to have cabriole legs, and it would be necessary to consider whether that would be suitable with the other furniture in the room. For No. 3, another draw leaf table, we cannot pretend to have much use. The space between the legs being filled with plywood gives a false effect of

massiveness, where one's knees would be grateful for the space.

105. Cabinets and Sideboards. (*Vol. V., p. 446*). The modern tendency is to build small houses and flats with plenty of built-in cupboards, so that furnishing can be reduced to a minimum. In one or more bedrooms, however, wardrobes are still required. These have become in recent years extremely simple pieces of furniture—plain, rectangular boxes with perhaps a slightly curved top or a bow front. All useless ornament has been discarded; surfaces are smooth and plain, without panels, recesses or mouldings to collect dust. However well arranged the interior, the outside achieves a Spartan restraint and simplicity. With simple shape and good proportion, the only other factor necessary is beautiful material; and that is offered in a profusion of rare woods from all parts of the world. The illustration of the wardrobe (No. 9) is a really beautiful piece of furniture in the prevailing style.

The first three sideboards illustrated are all simple in design and construction, but each is distinctive. The distinction lies in the proportions. In No. 2 the containing or outline shape is well proportioned and is raised on a framework extending slightly beyond each edge and supporting it adequately and comfortably.

No. 1 is very simple and yet complete. The stand and body are one, while the main part is divided into three drawers and two cupboards; a useful, unassuming and comfortable piece of furniture to live with.

No. 3 is not quite so plain; the straightness and squareness are modified with slight curves, bow front and cabriole legs. The inlay adds variety to the surface.

In No. 5 the stand is splendidly designed to carry and support the cabinet. The soft flow of the curves from the floor upwards is like a plant growth. This is a lovely transition from the slender legs up to the cabinet itself with its slightly bowed front and curved sides. Its elegance alone is sufficient to separate it from our own time to a period more fanciful and gentle mannered.

No. 4 is a bad example of a sideboard which has very heavy ornamentation, highly rounded panels and fantastic decoration in half circles which not only neutralises all proportions but actually runs across one end of each drawer, so that whenever a drawer is opened the ornamental scheme ceases to exist until the drawer is shut again.

The other sideboard (No. 6) has its surface broken up in every possible way. The cupboard doors have square panels of lighter wood, placed diagonally across them; the horizontal bars above and below the cupboards and the upright supports are all rounded and that effect is intensified by coating them with dark varnish and then rubbing it away in places, to give the effect of a rounded surface. A great deal of this effect aims at an appearance of massive solidity, which is quite unnecessary and unlikely in a piece of furniture of this kind. It also has bad handles and ungainly feet.

No. 7 has some resemblance to a bathing tent. Not at all an object one would wish to see when one first wakes each morning. How much more soothing is the simplicity of No. 9. The pattern of the grain of the wood is most pleasing.

No. 8 is an elegant, modern piece, dignified, well proportioned and arranged. The central mirror is

pivoted to tilt in its frame, while the two side ones are hinged to swing. It has little cabinets of three drawers on each side, while the larger centre drawer is set back to allow more foot space when sitting before the mirror. Notice particularly the way in which the blocks on which the cabinets rest are stepped back to keep them out of the way. One should always look at the feet of furniture. Avoid those that are ugly and noticeable and especially if they project in such a way that one would be sure to stub one's toes against them. This dressing table is a very satisfying piece of furniture. In spite of its squareness it has lightness and elegance, and forms an appropriate reflector for daintiness and charm.

106. Bookcases and Books. (*Vol. V., p. 448*). The two fancy-shaped bookshelves, Nos. 2 and 3 on the Plate, formerly appeared in almost every room in the house, possibly in the company of the one at the top centre. They are still to be found in many seaside boarding houses with the oddest assortment of volumes, together with the queerest-shaped vases. The bookcases are generally attached to the wall by tiny brackets and two nails, so that if one is not careful when selecting a book, down comes the whole thing, disclosing a patch of discoloured wall paper. Flower vases and books are things better kept separate—that is if one values the books.

Nos. 4, 5 and 6 are plain and simple book cabinets—neat, attractive and without ornament. Their aesthetic interest comes from proportion and the nature of the wood. Notice particularly how carefully the pattern of the wood grain has been selected and arranged

on the larger panels. Although the outline shapes are simple, the eye travels from one end to the other and everywhere finds something to interest and delight.

We come to the unit system of bookcase, No. 7. These units can be bought separately so that as the library grows the bookcase is built up to contain it. The units are made in different lengths, heights and depths, and each unit has two glass doors which slide along in metal grooves. This arrangement enables books to be kept free from dust and in proper order.

The illustration gives a good idea of the way in which these units can be built up and help to furnish a room. By alternating between cupboards and bookshelves, one gets a maximum variety without disturbing the general unity of the scheme. A long bare wall with one or two of these cabinets in position immediately becomes of interest, while very little floor space has been occupied. The steps made by the varying heights can be made to lead the eye in whatever direction is desired.

It is from this variation of height that the idea of steps has invaded a good deal of modern furniture. It relieves the boxlike structure in a simple and agreeable way and makes the rooms less formal and conventional while it retains the essentially architectural character which should be a feature of all furniture and furnishing. By an architectural character is meant that the things are four square, solid and having the appearance of being built-in as a part of the room. They have a permanent character, while the fancy and ornamental things have a temporary character. The one is durable and lasting; the other is passing and impermanent.

Turning from this bookcase No. 7 to No. 2 (an Empire bookcase with open shelves) it will be seen that one has only to take out a few books from one of these long shelves to have all the rest lying at angles.

When discussing with the children Class Picture No. 106, point out that Nos. 1 and 3 have no real design, but are flimsy and ornamental, difficult to fix securely on a wall, and at best makeshift arrangements for holding books, with unnecessary brackets for flower vases.

In contrast with these, it will be a simple matter to show the architectural design and construction of Nos. 4 to 7. Show the children how they are kept quite simple in outline shape and interior arrangement, with an eye to proportion and balance all through, and how their chief effect comes from the material itself—the grain of beautiful wood, kept either in its natural colour or slightly stained to bring out the pattern more clearly.

107. Type, Printing and Lettering—Capitals. (*Vol. V., p. 450*). In any lettering, whether printed or drawn, it is most essential that it should be easily read. Thus, it is very necessary to see that lettering is well shaped, well designed, and founded on a good alphabet.

The English alphabet in use to-day is derived from the Romans. In most respects it contains the same letters as can be found on Roman inscriptions in Great Britain and on the Continent. This alphabet, by its boldness and mathematical proportion, is an ideal one for inscription on stone, and its use for this purpose crystallised its form to one of absolute simplicity, directness and intelligibility.

That is what happened to our alphabet. In 1525 Albert Durer, one of the world's great artists, produced an alphabet simple in construction which can be readily reconstructed by mechanical methods. This alphabet was in turn derived from the inscription on the Trajan Column. From Albert Durer these two alphabets, *Roman Capitals* (Class Picture No. 107) and *Lower Case and Numerals* (Class Picture 108), have been designed and drawn by Leslie Badham, R.I., R.B.A. By following the guide lines on these Class Pictures anyone with a pair of compasses, a rule and a set square should be able to reproduce these letters exactly.

Each letter is composed within a square, and every part and every circle used in the construction bears some relation in proportion to the square. No attempt has been made to keep slavishly each letter strictly to the square space—B, E, F, K, I, J, P, R, S, T, each occupy little more than half the square. M and W have rather more than a square. This has been done for the sake of due proportion.

Each letter was drawn in a square of $3\frac{3}{8}$ in.; that is $\frac{27}{8}$ in. Each thick stroke is $\frac{1}{8}$ of the square— $\frac{3}{8}$ in., and the thin strokes $\frac{1}{8}$ of the thick strokes— $\frac{1}{8}$ in. Every radius used is some proportion of the square.

On both Class Pictures this construction is clearly shown. In capital letters which have a central horizontal stroke—B, E, F, H, P, R—the thickness of this is measured from the centre of the square upward, so that the stroke comes just above the centre to give the upper part rather lighter weight than the lower part. The centre of the S is also above the centre line for a like purpose. Note that the W is two V's and occupies a square and a half.

108. Type, Printing and Lettering—Lower Case. (*Vol. V., p. 452*). The lower case letters and numerals on Class Picture No. 108 may appear complicated, but as all the working construction is clearly shown it will be found much simpler than it looks.

The essential features of these two alphabets is that being built on a strictly geometric and mathematical basis, with all the parts of each letter related in size and proportion to the square that contains it, there is a uniformity which has ample variation and a consequent rhythm that delights the eye. That rhythm is carried on and completed by the spacing between the letters. Here there is no guide and one must trust to the eye alone. Hence, although the letters are constructed and designed, there is still a difficult part of the copyist to perform, for in each combination of letters there are irregular shapes between letters, and one should endeavour to make these balanced spaces of white paper.

109. Carpets and Rugs. (*Vol. V., p. 454*). The carpet is an important feature in any room. On its colour depends the general scheme and to a certain extent the style of furnishing. The chief difference between carpets and rugs is one of size.

Carpets can be roughly divided into three classes: (1) old Oriental; (2) modern reproductions; (3) modern. The first are of course expensive.

On the Class Picture, the top three are Ryijy rugs from Finland. The first with its trees and candles on a rich orange ground and its delightful picture panel is a very unusual design in a rug, and very lovely in colour. No. 2 has something of the look of a sampler—the same simple kind of pattern making. Notice

how the stars or crosses on the outer border are used to soften the line in parts but not equally all round. It has all sorts of artistic touches of that kind, a feeling for design that is very different from knowledge or skill, and that makes it precious. No. 3 has much the same quality, only in a more evenly distributed pattern. It, too, is a lovely colour.

We should particularly notice in these three examples the life, vitality and joyousness both in the pattern and in the colour. These are from 130 to 230 years old, and yet they retain their brilliance and harmonious colour.

Below these are three Oriental rugs, reproduced from genuine old rugs of considerable age, which have kept their life and sparkle and colour.

The following test might be used with the class. Take a sheet of paper and just cover the lower five examples on the Class Picture. Look at the upper part for a minute or two, endeavouring to keep the mind on the colour and general effect. When you have thoroughly absorbed the impression and can retain a mental picture on the retina of the eyes, quickly reverse the paper so that the lower part of the Class Picture is shown. Repeat this change over three or four times, until you have two definite impressions to compare—two impressions of colour. We think that all the adjectives you would use to describe the upper part would be on the joyous side—bright, sparkling, warm, cheerful, clean, healthy, and so on, while for the lower part they would be just the reverse.

The pattern of the five lower examples is modern. Some are only parts of a carpet, but enough is illustrated to show pattern and colour. Most of this modern

pattern is meaningless—it is without purpose, organisation or intention. It wanders about aimlessly in a distracted way. The parts are unrelated and the effect is worrying and fussy.

110. Curtains and Covers. (*Vol. V., p. 456*). When furnishing a house, a good deal of difficulty is always experienced in the selection of suitable curtains and covers. The kind of material must be decided by considering its wearing qualities, its thickness and texture, its surface and the way it drapes.

The colour must be in harmony or in contrast with other furnishing. It must give the right atmosphere to the room, and a further thought is—"Will it quickly fade?"

Pattern is difficult to decide. It will be useful to consider the pattern of the materials illustrated on this Class Picture. Taking the three pieces of material at the top, No. 1 is an all-over spot pattern; No. 2 is a soft fuzzy pattern; No. 3 is a bold vigorous one. These simple terms, spot pattern, soft pattern, and bold pattern, enable us to divide pattern into three groups, not that there are any hard and fast divisions between the three kinds. Some spot patterns are designed on a geometrically planned base; others have a linear pattern running through and holding them together. They may be dark spots on a light ground or light spots on a dark ground.

No. 2 is simply a soft wavy pattern. The essential character of this kind of material is that it is quiet and retiring, mysterious and elusive.

No. 3, a bold pattern, is geometrically planned. It has a horizontal, vertical and diagonal arrangement.

No. 8 is a modern design, original in many ways. It is entitled the "Pleiades" and includes sky and clouds, stars and planets, rainbows and huntress and unicorn. It is well designed and drawn, unusual in colour, clean and fresh in appearance. It is printed on a smooth, fine white cotton, and is a chintz. The name "chintz" is applied to-day to any glazed printed cotton. Any unglazed printed cotton is called a "cretonne."

No. 9 is a pleasing and effective pattern, and shows just what is meant by *formalising* in treatment. All ordinary visual proportions are discarded; one or two big leaves suffice to *suggest* the tree.

The charming little groups of deer, herons and tall reeds and grasses, are all treated in the same simple decorative way and fill in and complete the pattern.

No. 7 is printed on linen in the natural shade of the flax. It is a most beautiful printed fabric. Designed expressly to go with Persian carpets, it has been very successful. The colour is a delight. Printed in nine or ten colours, a great deal of thought and ingenuity have been used to get variation and quality through every part, so that while it is essentially a *printed* material, it has a similar effect and appearance to a fine Persian carpet. Note in this one the diagonal planning which resolves the basic pattern into a series of diamond shapes.

No. 4 is printed on cloth, woven with a wave pattern and is screen printed, which is really a method of stencilling with a roller through a mesh. This is a delightful fabric in grey and blue on a warm creamy ground. The darker pattern is a lovely greenish blue and the lighter leaves warm grey. This pattern is called "Bamboo Grass" and is also printed as a chintz in green and

fawn, blue and fawn, browns, etc., and it is printed also on linen. No. 5, called "Silhouette," is on satin and is also screen printed. The great feature of this fabric is its richness.

No. 6 is a woven fabric with something of a silky sponge-cloth texture in cream and gold. It is reversible, so that one can have either the gold leaves on a cream ground or light leaves on a golden ground. The side shown is actually the wrong side of the weave, but there is no reason why one should not use either side of any fabric if its appearance is preferred. With some printed fabrics the effect is so much softer and more melodious on the reverse side, that one should have no hesitation in making use of it.

111. Lighting. (*Vol. V., p. 458.*) We spend such a large part of our lives in artificial light that the consideration of the best means of lighting our homes is of first-rate importance.

Nos. 1 to 11 on this Class Picture show some early electric light fittings. From these it will be seen that they follow the style of their predecessors—the gas chandeliers, brackets, globes and shades. The gas chandeliers followed the former candle chandeliers and holders. This is the usual way with new inventions.

In the early days of electric light there were few ceiling lights such as are made to-day. The old wall brackets were clumsy with unnecessary fancy-shaped blocks of wood to fasten them to the wall. The chandeliers were adjustable by means of a counterpoise weight and pulleys.

Whether in a suspended lamp or a table lamp, or elsewhere, it is advisable to avoid cupids and figures

of every kind. The feeling one has about these things is, that if the figure is a good one it should be enjoyed for its own sake, and not put to utilitarian purposes. If it is not a good figure it has no place in the home.

Those old lanterns, whether old horn lanterns or suggestive of ships' galleys, are quite out of place for a modern illuminant. No. 11, intended to stand on the newel post at the foot of the stairs, would be a bad thing placed in the worst possible position. It would be bound to cast a checkered shadow round the floor and lower stairs, just where it is essential that one should be able to see clearly.

The standard lamp No. 9 is a fantastic shape in brass. It is far better to have a plain tubular upright, for it is simpler and more appropriate in every way.

Things should have architectural qualities rather than fancywork qualities, that is, things should look as though they were part of the place and permanent, rather than temporary or put there by accident. That remark applies also to fittings of all kinds, and if one remembers this, a great deal of fancywork will be avoided, especially in light fittings, brackets, table lamps, standard lamps, globes and shades, for all these things can have permanent rather than accidental character. On the right of the Plate central fittings for ceiling lights give a good idea of *architectural* design. No. 12 is what is called a "bulkhead" light; No. 13 is a modified light of the same sort; Nos. 14 and 15 show a range of shape, from the box shape to the more decorative shape. Nos. 16 and 20 have already been discussed. No. 17 is designed to project a little below the ceiling, to reflect light and yet be attached

to the ceiling by a ring support. Nos. 18 and 21 are *Bakelite* brackets. No. 19 is the architectural style.

Of the two table lamps, No. 22 is included to show that large vases used as the base for a lamp generally cast a big shadow surrounded by a narrow circle of light, which clearly indicates that a narrower base tapering toward the light is better. With all lamps like No. 23 we would use the same argument as we did about cupids and figures—they are wrongly used.

112. The Clothes You Wear. (*Vol. V., p. 460.*)

Dress materials are usually finer in weave and smaller in pattern than furnishing fabrics, and whatever the climate or weather conditions, the nearer the material is worn to the skin the finer it is. Dress materials not only have a smaller and neater pattern than furnishing materials, but they have also more life and sparkle and are mostly lighter in effect and brighter in colour. Things that are actually in contact with life must contain some of that life and vitality.

With regard to the statement "brighter in colour," it should be remembered that the smaller the patches, the brighter the colour. In a paint box there are no colours bright enough for the very small spots. It would be a great mistake to wear a whole dress of a crude shade of electric blue, magenta, scarlet, or any other aggressive colour. Also, one should avoid violent oppositions of colour.

The ground shade of a material should be toned and quiet because it forms a large mass, against which the small pattern can shine with the utmost effect. But one should particularly avoid dull, lifeless materials and muddy or turbid colours. Even in winter materials,

which are naturally quieter in every way, cloth has interesting texture and life in the colour employed.

Dress materials should have sparkle and vitality because they are always in movement, and movement in the patterning becomes a factor in the design. Just as movements are undulating and springy and not angular and jerky, so suggestions of movement in the pattern should agree.

On this Class Picture are shown a series of dress materials. In No. 1 the grey ground is printed on a white satin, leaving the white for part of the pattern, and outlining parts in a rather darker grey. The pattern is completed with gold which glimmers all through the design. White and grey and gold—a gorgeous material for evening dresses and gowns!

No. 10 is on a warm buff or biscuit-coloured material. The formalised flowers are printed in yellow and orange, with an occasional touch of green for a leaf—altogether a warm colour scheme and a pleasant type of material for everyday wear.

No. 2 is on a brownish linen, the groups of buttercup-yellow flowers and dark green leaves are spaced with smaller groups at intervals. No. 3 is a lingerie fabric with a soft, pale, grass-green ground, with white and pale orange flowers and blue-green leaves, all in a light scheme. Nos. 4 and 5 show the way in which patterns are often reversed. In No. 4 the pattern is printed in black, in No. 5 the background is in black.

The next two are such materials as children love to wear. No. 6 has white ducks on a blue ground; No. 7 is one of the fabrics specially designed by Mabel Lucy Attwell.

Nos. 8 and 9 have a novel feature—a gold printing which gives them an exceptionally rich appearance. No. 8 is a gold pattern on black, but in the reproduction one misses the essential glitter of the gold. No. 9 is a very beautiful dress material in soft bright colours, black and gold.

The purpose of this Class Picture is to give an impression of light dainty fabrics with small sparkling patterns of rich and lustrous effects in light schemes, and brilliant and scintillating darker fabrics.

One should endeavour to assess and convey the "mood" of each example as well as discuss the pattern effect and the material, and as these are each printed in a variety of colour schemes, one should try to imagine which colour scheme would suit each mood and fit in most agreeably with the nature of the pattern.

113. Arranging Your Room. (*Vol. V., p. 462.*)

The Plate illustrates two styles of furniture and furnishing, both essentially modern in design.

The furniture in the top room is extremely simple but well proportioned. Here it will be seen that the wood of the wardrobe and chest is carefully selected and the outside edges kept lighter to emphasize proportions, while the pattern of the wood is subtle and never obviously marked. It is easy to see from this Plate that in a room this plainly severe furniture is balanced by informality in the fabrics, curtains, bed-spread and rugs. A few darks are necessary in such a light scheme. Notice that even the spots of the drawer knobs are welcome small patterns. The picture and mirror complete the scheme and give balance. All the pieces are made about the same depth from back to

front, so that if they are against a wall, the fronts come flush. This enables one to put any articles side by side and avoid irregular frontages. The dressing table group is compact with everything convenient. The circular mirror gives variety in shape and is repeated in the bedside lamp (for that is the purpose of the round, capped globe on the right, which looks like an alarm clock).

We will now look at the other end of the room, the living and working end, illustrated on the lower half of the Plate. In daylight the writing table would be an awkward corner at which to write, but the general effect is very pleasing.

Many people would object to placing a vase of flowers on a radio receiver, but perhaps that is personal prejudice. The picture, books and accessories make this setting look very homely and comfortable.

The units fit in well together and give a sense of continuity, where separate pieces of furniture often look isolated and detached; the units, too, generally occupy less floor space.

It is always advisable to create a balance between somewhat conflicting desires. Furniture and fabrics must have some measure of agreement. Practically all the curtains and covers are vertical and horizontal in design. Vertical and horizontal lines suggest peaceful and restful feelings—those qualities that most people wish their homes to possess. To further such a scheme there is plain square furniture—cabinets, bookshelves, tables, all of the same height in horizontal lines resting on rectangular patterned carpets and rugs. Only the larger articles of furniture break the lines and they still continue the plain square shapes.

It soon becomes obvious that such an arrangement continued too far will produce monotony, so shapes must be included to counteract—a circular mirror to the dressing table, a round-backed arm chair to the writing desk. Note in the Plate how grateful the eye is for this relief. Then the book-shelves can be adjusted to form steps to build up and consolidate a corner, or to make gentle slopes and vary the horizontal lines.

In the fabrics there is generally some relief from the horizontal, for the natural folds of the curtains give them vertical stability.

It is this kind of balance that one has to try to attain. If the lines are peaceful, the other qualities must agree. The proportions must be graded and not too sudden. There must not be too violent opposition of light and dark, and the colour should be quiet and soft.

114. The Plan of a House. (*Vol. V., p. 464.*)

At the top of this Class Picture is a view, known as the elevation, of a bungalow. As is indicated by the water-butt, the bungalow is built in the country.

The plan shown in the lower part of the Plate is called an isometric view. The artist has shown it as though the house had been cut through and the top part removed. This enables us to see how the inside is arranged.

The bungalow consists of four main rooms, with a bathroom, hall and larder. In the middle are the four posts of a porch, also shown on the elevation.

The living room has the bay window and a door leading to the hall. Note the fireplace in the middle of the wall of this room on the right. Behind the living room comes the kitchen, with the kitchen range on the

same outside wall, so that there would be two chimneys on that side of the house, but these are not seen on the elevation. On the near side of the kitchen range is a dresser, and on the far side the sink and draining board. There is a wide window at the back end of the kitchen which would give plenty of light; and there are three doors, one leading to the back door, another to the larder and the other to the hall.

On the other side of the house are two bedrooms, with a chimney between them (shown in the elevation) so that each bedroom has a fireplace set at an angle and each bedroom has a large window in one end and a small one in the side wall. Notice that each bedroom has a door opening on to the hall; the dotted lines indicate on which side the doors are hinged and in which direction they open.

The inner walls are about half as thick as the outer walls, for the latter have to be thick to keep out the weather and support the roof, while the inner walls are only to partition-off the rooms.

The first door opens to the living room, which is on our right-hand side. The door next beyond that leads to the kitchen. Directly in front of us is a space of blank wall, and on our left is a small lobby with three doors occupying the sides of the square.

The one immediately to our left and the one slightly behind us lead to the two bedrooms. We glance into these in turn to get some idea of their size and to see that they are well lighted, and then turn to the door facing us which leads to the bathroom. A glance inside shows the bath in position, tiled walls and a window in the end; we can see there is sufficient space for all necessary bathroom fixtures and comfort in bathing.

So we leave there and enter the kitchen; notice the cooking range, dresser, sink and draining board, and observe that it is a fair-sized and well-lighted kitchen. Then we turn to the door in the middle of the wall on our left, which takes us into the larder.

On the plan we can see better than we probably should on the spot that this bath-room and larder have been skilfully contrived by blocking off the hall and making the back bedroom slightly narrower. The larder is not so long as the bathroom, for it has an end wall with a window in it; but it has ample space for all we shall need in a bungalow. So we re-enter the kitchen and turn to the far door; on opening this we find ourselves in a small lobby and at the back door of the house.

Having seen that all is compact, well arranged and convenient, with no waste space anywhere—in fact a well-designed house—we can turn our attention to the outside. A glance at the roof shows that its appearance has been well considered. Having a weather-boarded gable end to the living room makes a larger room and gives the roof more variety of shape. The bedroom end with its chimney stack and its sloping roof that has a slight hip make a pleasing contrast.

There are one or two further outside things that are better explained from the plan. Foundations are highly important, and as they are below ground level and covered up we can see how they are indicated only on the plan. First the ground is dug away level all round where the outer wall will come, and a layer of concrete about a foot wide is put all round this site. On top of this comes a thinner layer of concrete on to which the bricks are bedded—this is known as the footings.

Upon the footings the bricks are placed and the wall is built. Just above the ground level a *damp course* is put in. This consists of a layer of sound waterproof material (usually slate) inserted flat between the layer of bricks along the whole length of the wall, to prevent moisture from the earth creeping up and making the wall damp. In the front bedroom, part of the flooring is removed to show the joists or stouter timbers on which the floorboards rest.

Upon all plans it is usual to show the size of rooms as is indicated on the living room.

115. Pattern. (*Vol. V., p. 466.*)

Let us imagine a plain smooth wall. Being quite plain and smooth, it has no particular interest, it is merely a wall. We can give this an interest by adding colour; or we can give it interest by breaking up that smoothness with patterns of every kind. Suppose we lay out our first patterns geometrically, and square up our paper with diagonal lines, as in Nos. 1 and 2 on the Plate.

If we put a spot on each place where the lines cross we shall have an evenly spotted pattern which has vertical and horizontal direction, and also sloping direction to right and left. We can alter or add to this in several ways. We can put a small flower shape in place of the spot, as in No. 2, or make a larger group on every alternate centre, as in No. 1. The groups, too, might contain different shapes, while if one felt that the whole scheme was too regular and symmetrical, it would be easy to upset this precision by placing a spot or two irregularly within each square.

These patterns on the wall have no movement in

themselves, but they create a movement in the eye of the beholder. If they are simple and obvious patterns, we may see them without taking notice of them. There must be something of intrigue and interest by suggestion. The spots themselves produce a vibration rather than a movement, while lines tend to give directional movement, for the eye follows them along.

The next two patterns, Nos. 3 and 4, are from book jackets—things to be held in the hand and viewed at closer range. No. 3 is entirely formal and conventional and is obviously designed to convey that impression. We should certainly not expect a book with a cover of this kind to be full of action and drama or exciting adventure. Rather we anticipate a book of verse or essays. No. 4 makes a skilful use of the plain diamond latticing to give a different picture in each space and to introduce points of special interest in the faces which occur at intervals. Some of these are obvious and others mysterious.

The figures, No. 5 and No. 7 are very unobtrusive. In No. 5 one first looks at the design as a whole. Note its extreme simplicity and vigour. Then the eye lights on the face in the top border, follows the border along and finds a man's head below balancing the girl's head, and finally finds the reclining figure in the centre. This is probably a jacket cover for a romance. No. 7 is even more vigorous and expressive than No. 5. The little cupid with rounded cheeks blows and stirs the grasses with the wind and sets everything in motion. The shape of the design itself pointedly directs attention to the corners, and so suggests the winds from the four points of the compass; winds which blow across great expanses and set up eddies on their way.

No. 6 is intended to convey the recording of mystical events and dramatic happenings. In the top oval comes the figure of the scribe, events and drama are shown in the larger oval, while signs and portents are depicted in the surroundings. This is a very imaginative, well-designed idea. It is an excellent example of a symmetrical arrangement turned into a balanced design by the star with its comet tail, which adds much to the force, vigour and movement. It is big, bold pattern on the main circular shapes; smaller in the signs within the circles; smaller still in the curved and wriggly lines and stars of the lower sides, and still finer in the two oval pictures. This relieves the design from the bare black and white and gives it a tone quality. It is as carefully adjusted in tone as it is in pattern.

No. 8 is an example of radiation. Note how the straight base and sides of the outline shape are a relief which emphasizes the curves within, while the variety in line and texture give it gradation and sparkle. The ears of corn go one way and the stalks and weeds and tares another. There is no outline to the sun, but a series of surrounding circles suggested in the pattern give the effect of a glow of light. The actual centre of radiation is displaced by the curved lines on the left, and the sickle or reaping hook.

No. 10 is such a simple piece of decoration and such a very lovely bird that it tells its own story. It is so purely imaginative a creation, and rears so majestically against a star-lit sky, that our minds are immediately carried away to a world of fantasy and romance.

No. 9, from the Chinese willow pattern, is the best example of what we have called "formalisation." One could not mistake the tree for anything but a willow,

although one may never have seen a willow like it. It has all the essential character of the willow expressed simply and decoratively.

116. Rhythm. (*Vol. V., p. 468.*)

The passing rhythm—a magnificent piece of decoration—is on a screen of about the average height and in six folds. The scheme is in black and white and gold. All the round-edged cloud in the upper part is gold, against which the white birds, the snow and the opposing darks, tell out with a splendour that must be seen, for it is too wonderful to imagine. (The vertical lines across the picture are the folds of the screen.)

There is no difficulty in accepting the two drawings as *passive* and *active* respectively. One is opposite and complementary to the other, and the two are examples of extremes of rhythm. The one is as near to absolute placidity as possible, and the other shows action throughout. But the passive is without sentimentality or lack of vigour; and there is fierceness and violent movement in the active without becoming too dramatic or theatrical.

The title of Shiko's work is a poetic conception, but it tells exactly what the painter sets out to convey—*Winter Melting into Spring*; not "turning" or "passing," but "melting." That implies a late fall of snow; when this melts, the earth will once more come to life and repeat the wonders of spring.

But first *winter*—that is the essential subject—snow, heavy weather, an old tree and three or four white herons. The tree selected is a willow, on account of its twisted and gnarled trunk and the suggestion of sadness in its drooping branches. This is set against a huge

golden cloud. Why not? We often speak of golden cloud, why shouldn't the artist paint one? This is another poetic conception in keeping with the central idea.

As regards the planning, the whole of the pattern comes within a triangle with a long base slightly exceeding the length of the picture and thus suggesting the utmost stability and permanence. Being in six parts, the picture has a definite middle line so that the triangle is not symmetrical. Notice how it has been balanced by a smaller triangle made by the groups of herons, and how there are other triangles all through the design. With these are contrasted the curves of the tree and the outlines of the cloud. The long line of the snow acts as a suggestion of horizon, beyond which we get glimpses of dark cloud. In the foreground one or two early blossoms give a hint of the coming of spring.

The idea, the choice of material, its placing, proportions and distribution, are all so related and so work together to one end, that the picture has a unity and completeness.

There is nothing so satisfying as a complete work of art.

The other picture is simple enough in its elements—three peaks of rock and tumultuous seas. But how magnificently this has been marshalled and presented! There is an unusual feature. It looks as though the picture was an horizon, and yet instead of clouds above, the waves seem to continue. They do continue. That long white horizontal band which fades away at the top corner is a convention for mist or cloud. Chinese and Japanese artists used it for centuries. Its real purpose was to introduce a difference of texture in the design and a difference of feeling to the mood of the

picture. In this case its use is admirably justified, for it *suggests* an horizon, and intrigues and interests us in a part where the wave repetition might have become monotonous. It also makes a splendid foil to the whirl and fury of mighty forces and carries the mind on to the calm that comes after.

Now let us look at the construction of this wonderful wave pattern. The waves are not easy flowing, but a rapid up-fling, a sharp curve, and a sudden descent. This line achieves the greatest possible energy and force and is constantly repeated in each wave to give each surface added power and movement. The lines of waves follow each other in irregular formation and are broken all over by the white caps of foam. These rear and move in all directions and add conflict to force and movement. The rocky peaks give stability and their broken and jagged outlines show signs of the power and continuity of the elements which they oppose.

The little trees on top of the near rock remind one of an eagle with outstretched wings poised for flight. It is an appropriate suggestion. No doubt the artist foresaw that and hoped that it might occur to the beholder, for it is perfectly in keeping with an imaginative creation.

The picture is consistent in every way and throughout it is drawn with a severity that equals the subject matter. It achieves consistency of pattern from corner to corner, and the rhythmic flow infuses the whole design. It is imaginative in conception and in technique.

117. Pictorial Design. (*Vol. V., p. 470.*)

By design we mean the right selection and use of lines, proportions and colours in an order best fitted

to convey what we feel or wish to say in our pictures. For our studies we have outlines of several well-known pictures. (Reproductions of some of the pictures are given in Vol. V., p. 470 *et seq.*)

No. 1 is a Japanese woodcut as slight and simple as an Indian ink drawing. Its lines are so few, yet so carefully placed—principally horizontal, offset by the mast, which is just off the centre. This triangle of mast and line to the stern give great stability to the design. Most of the lines are slightly curved, thus giving the gentle motion which makes this picture so soothing and restful.

No. 2 is *The Avenue* by Hobbema. The main scheme of this picture is the uprights of the trees. (In No. 1 it was the horizontals.) Note how ascending verticals suggest affinity with all up-springing and upward-tending qualities, and are consequently joyous and pleasing. The centre at the end of the avenue is admirably placed. If you were asked to place a tall thin letter M (for that is the shape of the group of trees) on the picture space it could not be better placed than it is. From there we can follow the lines of the poplars upward to that serene silvery sky.

No. 3 is the outline of a drawing by John Sell Cotman. It is included for its square character. Trees, massive and square, set one behind the other, give a feeling of architectural stability and permanence that make this a characteristic English landscape. As it is a monochrome drawing without colour, we may well imagine that Cotman felt its proportions were sufficient in themselves and needed no addition.

No. 4 is a diagram of *Fuji Seen in the Trough of a Wave*, by Hokusai. It is usually known as *The Great*

Wave and is considered by some to be his masterpiece. Every line is expressive of power and grandeur. Its mighty sweep overshadows all the sea pictures we know. This is the sea in stern and relentless mood; the foam breaks into tentacles that reach out in all directions, and the boats with their oarsmen are only just seen, as they appear to become part of the rush of waters. Notice that the main curves attain the utmost dynamic force and weight, and that their upward fling is artfully increased by the repeating curve along the bottom edge, while the nearer, lower crest serves to buttress and support the main body. Even the troughs have their main lines laced and strengthened by converging curves of force and direction. The edges of foam become broken and claw-like and fling out a starry glitter of spray that adds vitality. The whole of this is set against the rosy glow of a sunset sky.

We see in this how an imaginative conception far outweighs any naturalistic vision, how the *line* makes it dynamic, and the *proportions* give it power and dignity.

No. 6 is also by Hokusai, but it is in lyrical mood. This is from the wood-cut print series *One Hundred Views of Fuji*, issued in book form in 1834-35. In this series Hokusai drew one hundred views, each having the triangular shape of the mountain Fuji as a *motif*. He used every possible device and method of design, and it is from this point of view that they are of extreme interest to students, though they are of such beauty that they appeal to all.

The design is a form of radiation. On the Class Picture are shown only the main lines. All the chief curves of the bamboo stems radiate from a common

centre somewhat below the left-hand side of the picture; the rest were put in so that the method should not be conspicuous. Behind these is seen the mountain. The top and right-hand sides are enclosed with the long spiky bamboo leaves, and the lower left-hand is contained by the bank on which the bamboos grow. These long radiating curves give the effect of a slow movement, a gentle swaying rhythm, that contrasts effectively with the austere dignity of Fuji. We have said that the mood is *lyrical*; by that we mean that its sensations are warm, soothing and agreeable.

No. 5 is a diagram of the well-known picture of Whistler's portrait of his mother.

There is no doubt that the artist had been greatly influenced by the Japanese prints which had only recently been introduced into Europe. Their decorative qualities, linear design, proportion and balance gave a new impetus and outlook to the period, and Whistler was quick to absorb and fashion them to his manner of painting. This portrait is clearly a design of balance and proportion.

On looking at the *Portrait of the Artist's Mother* one might possibly be tempted to think that the curtain part could be dispensed with, but by masking it off one is quickly satisfied that the curtain forms a splendid and logical balance to the black dress. Balance is the essential feature of this design.

No. 7 is a diagram of *The Dismasted Brig* by J. S. Cotman. It is a very beautiful water colour, free and spontaneous in handling, with all Cotman's facility in laying clean washes of colour and leaving them untouched; fresh and breezy in feeling and colour and very soundly designed. It is an interesting design which

introduces a form of construction that we have not met until now.

The mast still standing makes the disability of the brig more evident, and this remaining mast becomes the central incident. It forms a triangular shape just off the centre.

By its pictorial importance that triangle becomes the *key* pattern of the design, which is consistently triangular all through in larger and larger shapes. So this form of design is sometimes called "the enlargement of the key pattern." The mast with its billowing sail stands boldly silhouetted against a triangular patch of light sky; adjoining that is a rather darker similar shape; these in turn are broken into and suggest smaller patterns of like nature. This pattern is repeated throughout the sea and in the distant vessels.

Nos. 5 and 10 on the Class Picture are splendid examples of *static* (or still) balance. This Cotman drawing is an equally fine example of *active* balance. We shall find in No. 9, *The Greco*, the same principle used to express a mental stress and anguish. The original of this Cotman drawing, with its atmospheric qualities of light and colour, is absolutely convincing and natural. In the small reproduction it appears rather more dramatic, but has the advantage of showing its organisation. Sufficient contrast to the angularity is obtained by a curve here and there. These are logically occasioned by the sail in the key pattern.

No. 8 is a diagram of *Ulysses Deriding Polyphemus* by J. W. M. Turner.

We have put these two sea pictures next to each other as in many ways they are exact opposites. The Cotman is light, fresh, clear and breezy; the Turner, rich, glowing and mysterious.

That is the essential quality of this picture—its soft, melting tones, glowing lights and shimmering darks, and over all its atmosphere of strange beauty and *mystery*. And in spite of all this envelopment, it has a sound basis of design.

In this picture Turner has succeeded in reconciling two powerful pictorial interests—a sunrise and a beautiful ship. Inevitably one of these must predominate, so light and colour naturally have first place; but he puts the ship nearer the centre and the sun well out to the right. The ship is a ship of dreams, a fairy galleon, but the painter's extensive knowledge of ships enables him to give it these qualities without losing sense of reality, as in the same way his experience allows him to make this sunrise the embodiment and summing up of *all* the strange beauties of sunrise.

In a picture where outlines are lost and everything softly suggested one may find difficulty in following the linear sketch. The ship is set against a pyramid of dark, while the uprising of the sun is accented by the dark rocks on one side and the ships of Ulysses' fleet on the other, so that we get a pyramid of dark, and an inverted pyramid of light. If you were to trace the one, and reverse the tracing over the other, you would see that they practically coincide, so that the two halves of the picture (the top and bottom which fit into each other) are almost exactly equal in area. The golden rod proportions show something of the extraordinary precision with which things are placed by the artist's hand and eye.

No. 9 is a diagram of *The Agony in the Garden* by Greco, 1525-1614.

The design belongs to the last period of his life. Greco made some half-dozen paintings of this subject,

this being the final version. In it he made some daring innovations. His sole consideration was to attain a perfect unity between his subject, his design and his colour. His previous efforts had convinced him that in order to express what he wanted, the picture must have a *supernatural atmosphere*. That meant discarding all naturalistic treatment and concentrating on design and colour alone. So in place of all ordinary visual proportions, *relative* proportions have been used. A figure or an event is made of a size that its importance in the scheme warrants, and that scheme is to convey Christ's agony in the Garden of Gethsemane. An agony would seem an impossible thing to paint, but Greco succeeds and does so by his design, every part of which is expressive. The small line drawing gives some idea of this. An agony implies a sense of instability—everything in a whirl and a state of flux. Now look at the line analysis: right across the foreground we have a breaking wave form and similar curves of vapour or cloud swirl through the design. The golden rod proportion marked on this drawing shows that a line from the bottom corner to the top at this proportion, and a parallel line from the bottom of this perpendicular, give the main lines of displacement. Christ's head comes on the golden rod proportion, and His body fills the lower corner of this rectangular space tipped up on its diagonal. The disciples are shown asleep in the whirl of the wave form; on the circular sweep the angel advances. To the right, across an expanse of dark sky, we have a second series of swirling cloud masses with the half-veiled moon in the hollow beneath.

Note also the number of triangular shapes and see how several are dark and heavy, particularly the one

between the angel and Christ, and the one, ominous and portentous, that hangs poised above His head.

With No. 10 we return once more to normal vision and homely setting. Our picture is by Vermeer of Delft, 1632-1675. It is called *The Lady Standing at the Virginals*. On the Class Picture, this and the one above it are shown in mass, while the rest are in line, as this *mass proportion* is their essential feature.

It is the exquisite balance of masses, proportions and colour which make this picture one of our most prized national possessions. Its pattern can be compared only with the finest of the Japanese prints. Its colour is infused with the warm diffused glow of sunlight, brought to a climax in the reddish gold picture frame on the left, and dominated by a most lovely blue, which is a perfect contrast. To this is added a three-dimensional effect which is so consistent and convincing that it has become the marvel and despair of all later artists. Every part is so exactly right in value of tone, colour and atmosphere. The girl's head comes some six or eight feet in front of the black frame and this without any blurring or softening of edges, such as lesser artists are compelled to use. So that when we spoke of a return to normal vision, we were not referring to this artist's vision, where everything is exactly related and hand and eye perfectly attuned.

Here the idea of the small picture (intended to be viewed at close range) is attained. It reaches the highest peak of the endeavour to create a picture which is like an open window, or has all the semblance of reality, but a reality ordered and conditioned by a master hand and an exquisite sense of values and balance.

No. 11 is one of the very first oil paintings ever

produced. It was painted by Hubert van Eyck, 1366-1426. It is called *The Three Maries at the Sepulchre*, and is in the Cook collection at Richmond.

In this instance there is some difficulty in separating the basic design from all the carefully painted incidents and details. Quite often the structural foundations get overlaid with the accessories, but though we may be unaware of this groundwork, its influence is felt. The picture shows the open grave with an angel seated upon it. At one end the three Maries are grouped, and around are the sleeping forms of the watchers. The background is formed by rocks on either side and a distant view of the town. On the Class Picture the open grave is emphasised, as also are the two diagonal lines pushing outward from the interior of the grave to the corners of the picture.

The subject, when divested of all its trappings and incident, is really: *Christ is Risen*. Does not this little diagram express this with conviction and simplicity? Is it not the exact formula which conveys in the fewest possible strokes *Christ is Risen*? And so we find that the very shape and plan of the design itself embodies the message of the picture; and that there shall be no doubt about it, this V-shape arising from the open grave is repeated at the bottom below the sleeping figures, as a main line frequently is repeated to give it emphasis. The whole design is a sort of *ideograph* or picture writing, and if you can draw something of that kind, your picture cannot fail to express what you intend it to say.

118. Endpapers. (*Vol. III., p. 26.*) Types of and hints on endpapers. Illustrations of specimen pieces

for mounting to assist children in selection and encouragement powers of criticism.

1. *COLOUR COMBINATIONS.* Much wastage of valuable material may occur unless children have some guidance in choice of colours. Specimens are mounted on sheets of cardboard ruled off as shown, using a lettering nib and black Indian ink. Each rectangle represents one board of a book and measures $5\frac{1}{2}$ in. by $3\frac{1}{2}$ in. (postcard). For quarter-binding the narrow rectangle may then be a quarter of the width of the board ($\frac{7}{8}$ in.), leaving $2\frac{5}{8}$ in. for the width of the larger rectangle. The cloth is then applied using for preference the dry mounting method.

2. *SIMPLE WASH.* The simplest method is where a wash of water colour is uniformly spread with a small sponge or pledget of cotton wool, all over an imp. 4to sheet (15 in. by 11 in.), so that when dry and cut in two there are two 8vo sheets which match very well. This is better than trying to do two 8vo sheets separately.

3. *STIPPLED COLOURED PASTE.* Some fairly thick flour paste is coloured by adding coloured water—not by adding dry powder direct. Tempera colours are splendid for the purpose. This coloured paste is taken up by a large brush, 1 in. to 2 in. in diameter, and stippled all over the paper, the brush being given a perpendicular action. Another colour may be stippled over or between the other, using different brushes.

4. *COMBED COLOURED PASTE.* When the colour or colours have been applied as above, a good

effect may be produced by using a strawboard comb, with teeth not necessarily uniform in width, to draw lines in the same or varying directions. Good duplicates of any of the above may be had by rubbing a damp sheet into contact before the coloured one has had time to dry.

119. Endpapers. (*Vol. III., p. 27.*) Further specimen pieces for the selection of attractive endpapers.

5. *COLOUR PASTE "THUMPED."* The two coloured pastes may be put on different sheets, the two placed face to face and thumped with the hand or a pad made of a large duster. The result is a splashing of the colour, often very effective.

6. *COLOUR BLENDING.* A simple but effective manner of making endpapers that can be used in the very early stages. There are two types; (*a*) blending different tints of one colour; (*b*) blending different colours.

(*a*) Blending the same colour. The drawing paper should be wetted under the tap or dipped into a large photographic dish, and used while in a very damp condition, thus enabling the colour to run and blend more easily. With a large brush, size 8, a little strong colour is painted in lines, roughly parallel, though not necessarily straight, across the paper. The more pleasing effect is when they are not straight. Owing to the damp condition of the paper the colour should run freely, producing a "pattern." The "lines" of colour can be assisted in running by adding a little clean water between the lines.

(b) Blending of different colours. There is an unlimited variety. The procedure is the same as for (a), except for the use of different colours.

When dry, all the above may be ironed with a fairly hot iron, the papers gaining by having a matte surface. Starch may be used instead of flour, when the result will be a higher gloss after ironing.

7. OIL BATH METHOD. Some cold water is placed in a large photographic dish of the enamelled type as used for 15 in. by 12 in. prints, and warm water is added to a depth of about 1 in. To all this is added a few brushfuls of warm glue from the glue pot. This forms a size.

A selection of colours ground in oil will be required—artists' tube colours give a greater selection, though the cruder kind, bought at the colour merchant's will do. About 1 in. of colour is pressed from a tube into a bottle, some turpentine is added and the mixture is well shaken. The colour is then sprinkled on the surface of the size and the coloured oil floats and spreads.

Another colour shown by the colour circle may be added, and patterns drawn with a knitting needle or by a number of pins held between two pieces of glued strawboard.

The first colour thrown on spreads most. Too much oil results in too much spreading; if too little oil is used the colour falls to the bottom. Paraffin may be used instead of turpentine, but both must not be used together. A sheet of paper is then dropped on the surface. Care should be taken to see that no air bubbles are imprisoned, or white patches will result. Drop on a diagonal of the paper and let the corners fall away

therefrom. When it is desired to clean off the colour in order that a fresh combination may be tried, it is best to use pieces of newspaper. Two colours are perhaps best; do not neglect black. Placed round on the heated school pipes, the sheets soon dry.

8. *STICK PRINTING.* Another method of making endpapers may be considered a good introduction to original design work. At first, bought sets should be used containing circles, squares, triangles, rectangles, etc., and these surfaces again cut across. In using these a child discovers that he is building up something he likes very much. When he has combined these shapes and used on the same sheet different colours which harmonise, he is progressing. Some of the class will later on produce original brush work. With the aid of files of different shapes and sizes, original forms may be made on short lengths of dowel rods, etc., Tube water colours or dry powder colour dissolved in a little water and either kind mixed with flour paste gives a colour with a good "body." A piece of flannel soaked with colour and lying in a saucer makes an effective pad.

120. Edge Stencilling. (*Vol. III., p. 28.*) Endpapers produced by a method known as edge stencilling can be beautiful. Beginning at the top righthand end of the paper, the colour is first stencilled on. The stencil is then moved down a marked distance and the same operation carried out; but in addition, an almost dry brush graduates the colour up to the dark of the first strip. Once again it must be repeated,—an almost dry brush is used. The process is repeated to the end

of the paper. A dome-shaped, rather than a flat brush, is better for the flicking, graduating action. The stencilling may be done at an angle. More than one colour and more than one stencil may be used on the same sheet.

Fig. 10 shows a number of edge stencils in position for the next line, and the results of their previous use.

121. Interior Stencilling. (*Vol. III., p. 29.*) This is the more familiar type of stencilling. A suitable unit may be repeated (1) along parallel lines; (2) rotated clockwise in a circle, square, triangle or any regular polygon; (3) inverted within a rectangle.

For the stencil, use ordinary cartridge paper, which has had applied to it a light coat of French polish. The stencil can then be washed with a sponge after use and stored for future use, if so desired. An endless variety is possible, starting with straight lines and finishing with curves or combinations of both. The lines need not necessarily run horizontally across the paper.

122. Potato Cuts. (*Vol. III., p. 30.*) Simple designs cut on a flat piece of potato and cleanly repeated over a sheet give a pleasing result. The chance of turning over or inverting the potato must be carefully guarded against. Apply the colour with a brush or from a pad. A piece of 3-ply wood, covered with blanket (blanket boards) makes a useful cushion while the design is being impressed on the paper.

123. Cover and Wrapper Designs. (*Vol. III., p. 31.*)

LINO BLOCKS. The use of lino blocks for repeating a pattern is too well known to need elaboration. Briefly, (1) a design is pencilled, painted or traced on

to a piece of the plain rubbery type of lino; (2) the design is cut around or away, using a V-tool for narrow spaces, a small penknife for straight lines, a gouge for cleaning away larger areas.

Before cutting the design stick the piece of lino, using glue, to a piece of timber 2 in. to 3 in. high, and with ends similar in shape to the piece of lino. During cutting, the mounted lino may be locked in a vice and both hands are then free to control the tools.

Having cut the design, it is next inked with a small squeegee, which has been rolled over a thin film of ink spread on a piece of plate glass. After inking, it is sighted over its next position, lowered into place and pressure applied with both hands and shoulders.

It may happen that much larger lino blocks are being used for endpapers. They may be 5 in. by 4 in., or even larger. Such a size had best be transferred with the aid of the letter press and blanket boards. Too great pressure must be avoided.

In a lino block but little recession of tone can be suggested. One has to depend on recession of line, hence the drawing must be reasonably correct. It is unwise to try to include too many planes—perhaps three can be handled by the expert. Too great detail is not expected from the medium. Masses are more sought for.

For all lino blocks a thin, strong, rather tough paper is best. If necessary, and before use as an endpaper, it may be lined.

FREE BRUSH WORK. This type of work is the most important of all; the other stages being merely training for this stage.

The best boy or girl is shown how to begin a simple drop pattern, counterchange pattern, or chequer pattern of, perhaps, postcard size. Do not attempt large sheets, it is too much to expect. Variety adds zest to the work. Inexperience makes children more successful and original in this type of work than many adults. They do not worry about "laws" and never stop to think if the work will be admired. The result is their own and consequently much more worthy of admiration than if copied. It is a fine form of applied art, and may well occupy the art and craft time of those children who are best at the work.

Shiny cloth is unsuitable. A matte surface gives better results, as the water colours hold better on a cloth which has some "tooth." When finished, the colours may be fixed by spraying with a fixative or by lightly painting over with a solution of bleached shellac in methylated spirit.

124. Lino Cuts. (*Vol. III., p. 32.*) A hundred suggestions for lino cuts suitable for decorative patterns on covers or wrappers. An idea is given of the endless variety of this type of work and also of the appearance of the design when reproduced, (see note on Class Picture No. 123).

125. Water Colour. (*Vol. III., p. 33.*) Perhaps the most ambitious of all endpapers are those wherein attempts are made at pictorial work in water colours, or pastels, pen and ink, or brush and ink.

Children living in industrial areas attempt with great success pictures of house roofs, chimney pots, smoke

and factory chimneys beyond, of a weigh-bridge, horse, cart and coal, and tall cooling towers beyond; of a high curving bridge, supported by lovely arches and being crossed by a laden train.

The organisation of parties for outdoor sketching will result in dozens of subjects.

The glory of a landscape in the eyes of most people is in the colour. Lines are not so obvious. Composition is not soon appreciated, therefore monochrome work is important.

"In the best schools to-day, early on, the technique of bookcraft is married to art and care is taken that divorce is ever after unknown."

126. Titling. (*Vol. III., p. 34.*) At one time it was thought sufficient if the title was put on with brass type using foil of different colours. This calls for more physical strength than most children have, and should not, except in rare cases, be attempted in the school. All children can, however, print.

It is a good thing to show the children some work and invite their comments. If they can see the teacher's work, they have a foundation and a model from which they can work their own ideas. It is all to the good if they criticise and attempt to improve on the suggestions given them.

The lettering may run diagonally, but if wished circular, semi-circular, vertical, horizontal, elliptical styles, etc., may be tried. All the letters are the same height, but this may be changed if desired. Something on the cover which illustrates the contents should be incorporated.

127. Samples of Weaving—1. (*Vol. V., p. 355.*) Various articles woven by students. Details of threading drafts are contained in the volume as above.

1. *SKIRT LENGTH.* Vegetable-dyed wool; single ply wool warp; hand-spun (on spindle) wool weft; 14 threads per in. Short strips of wool of different colours inserted in the weft for a portion of each shed, at intervals.

2. *OLD PERSIAN TAPESTRY.* Cotton warp; 14 threads per in. Fine vegetable-dyed wool weft. Short slits apparent at the junction of two colours.

3. *SAMPLER IN 3-PLY WOOL.* 14 threads per in., made on small roller loom; patterns darned in with shuttle. No. 1 pattern at bottom of sampler, No. 9 at top.

Details of borders as follows:—

No. 1 shows a reverse twill (over 3 under 1).

No. 9 shows a plain twill.

No. 2 pattern is made by passing six rows of coloured weft through the same shed, each row being followed by one row of tabby weaving.

No. 5 pattern is produced by weaving alternate rows in orange and green; plain tabby weaving.

No. 6 shows a twill (over 2 and under 2) in two colours, which give a pleasing variation of the twill produced by weaving with one colour only.

4. *SCARF.* 2-ply vegetable-dyed wool. Table loom; 14 threads per in. Blue warp; green weft; rose-path pattern in orange.

5. *WORKBAG*. 2-ply warp, hand-spun weft; all vegetable-dyed. Made on braid loom from two strips each 6 in. wide and one strip (at top) $2\frac{1}{2}$ in. wide. Pattern darned in with shuttle; twisted cord, strip for holding cord made by weaving on a foundation of 5 strands. The "construction" in this case forms the "decoration"—an excellent plan to adopt when ever possible in making up hand-woven fabrics.

6. *SCARF*. Woven by girl of thirteen. Table loom; 2-ply vegetable-dyed wool for warp and weft (warp more tightly spun); 12 threads per in. Colour scheme taken from butterfly's wing.

7. *BRAID*. Woven by girl of twelve on Scottish inkle loom; 4-ply wool, 28 threads per in. Warp pattern (weft entirely hidden by warp).

8. *WORKBAG*. Foot power loom. Honeysuckle pattern. Single ply (imitation hand-spun wool) used for both warp and weft, 14 threads per in.

9. *SCARF*. Roller loom with metlyx heddle; 3-ply wool, 14 threads per in. Warp in two colours, mauve and pink alternately; weft mainly saxe blue but centre strip of scarf woven with alternate rows of saxe and jade; pattern for borders darned in with shuttle in same colours as the warp, with the addition of a touch of jade.

128. Samples of Weaving—2. (*Vol. V., p. 356.*) Further illustrations of woven articles. Details of threading drafts are contained in the volume as above.

1. *SCARF*. Woven in 3-ply wool on table loom. Honeysuckle borders, hemstitched ends (3 warp strands in each group).

2. *HANDBAG*. Woven in 2-ply vegetable-dyed wool (16 threads per in.). Honeysuckle borders. Handle made from a continuous strip of tablet weaving (10 tablets), threaded through slits in the wooden frame.

3. *BAG*. Woven in 2-ply vegetable-dyed wool (14 threads per in.). Braid loom; inlay pattern darned in with shuttle. Bag made of three strips; the two bottom strips joined together with groups of blanket stitches; the top strip joined to the middle one by sewing through the loops at both edges, on the wrong side, so that the work lies flat. The bag is finished off with a strip of crochet with slots through which a double cord is threaded. Green linen to match the colour of the inlay pattern is used for lining the bag.

4. *SCARF*. Woven by girl of thirteen. 2-ply wool warp; hand-spun weft of ERI silk; all vegetable-dyed. 16 threads per in.; knotted fringe.

5. *POCHETTE*. Woven on a four-heddle box loom. Welsh tweed yarn, natural colour for warp and weft; 14 threads per in.

6. *PLAID SCARF*. 2-ply wool; table loom; 14 threads per in. Same colours used for both warp and weft. Hemstitched ends.

7. *IRON HOLDER*. 2-ply wool; braid loom; pattern darned in with shuttle. Strips and edges joined with blanket stitch.

8. *CURTAIN*. 2-ply wool in green tints. Natural grey, fine single ply wool weft (used double). Foot power loom. Honeysuckle borders in green 2-ply wool knotted fringe.

9. *BAG*. Braid loom; 2-ply vegetable-dyed wool. Bag made of three strips, two plain and one pattern.

10. *SCARF*. Table loom; 2-ply wool. Honeysuckle borders. Warp of green shades (vegetable-dyed) wool, 16 threads per in.; knotted fringe.

11. *TAPESTRY BAG*. Board loom, 2-ply wool, 12 threads per in. Plaited loops and wooden buttons used for fastening.

12. *HANDBAG*. Woven by girl of thirteen. 2-ply wool; 14 threads per in. Cleveland web pattern.

13. *SERVIETTE*. In mercerised cotton. Table loom. 28 threads per in.

14. *BELT*. Warp of 2-ply wool used double; 14 threads per in. Weft of 3-ply wool. Belt woven on metlyx heddle used as a "waist" loom. (*Note*.—2-ply wool used double produces a finer and flatter piece of fabric than would be possible if 4-ply wool were used.)

129. Weaving in Wool and Cotton. (*Vol. V., p. 369.*) The samples on this chart have all been woven either in wool or cotton. Details of threading drafts contained in volume as above.

1. *SCARF*. Woven in 3-ply white wool, back pattern; 4 threads per in.

2. *POCHETTE* to match the above-mentioned scarf.

3. *SCARF*. In 3-ply wool, woven by girl of thirteen; 14 threads per in. This is an original adaptation of an American threading draft.

4. *BLACK AND WHITE BAG*. Woven on four-heddle box loom. Pattern darned in with shuttle.

5 and 6. *TWO SCARF ENDS* woven in 2-ply wool on four-heddle home-made box loom. Rosepath threading draft.

7, 8 and 9. *BAG AND POCHETTES* woven on four-heddle box loom. These represent early experiments in pattern. No. 7 shows a border woven from the monk's belt threading draft.

10. *CUSHION*. In shades of brown and rust, 3-ply wool. Woven on home-made rigid heddle shown alongside the cushion. Note the ingenious method of cutting and joining the strips.

11. *WORKBAG*. Woven in natural grey wool (2-ply). Blue-green borders from honey-suckle threading draft.

12. *CUSHION*. Woven on table loom from butter-nut threading draft. Natural grey foundation, green pattern. 14 threads per in.

13. *CUSHION*. Woven in mercerised cotton on foot power loom. Beige ground, orange pattern. Note the interesting border. Orange peel threading draft.

14. *NEEDLE WEAVING* in blue and green mercerised cotton on cream cotton foundation.

15. *NEEDLE WEAVING* in coarse mercerised cotton on hand-woven mercerised cotton foundation.

130. Tablet Weaving. (*Vol. V., p. 413.*) The belts in the illustrations are woven in macramé string and in most cases have an attractive home-made buckle attached. Hints on construction are printed on the picture.

Tablet weaving is one of the oldest crafts and several pieces exist dated about the sixth century. Tablets belonging to the Roman period even have been found. These were made of bone, and in the East are often made of leather, old playing cards, etc.

The braids were used for harness for camels, belts, edges of shawls, etc., and some most interesting examples are to be found in museums; e.g., South Kensington, Royal Albert, etc.

Tablet weaving is particularly suitable for school purposes and forms a definite stage in the history of weaving. From experience it is found that certain types of children take to tablet weaving more than others and these children should be allowed the fullest possible scope for experiment and practice. The principles of tablet weaving having been briefly explained and the children allowed to see a few good examples of work and a few pattern drafts, they can be left to experiment by themselves. Tablet weaving needs little teaching and best results are obtained if the suggestions indicated above are adopted.

Full details of method are contained in the volume as above.

131. Linoleum Block Prints in Colour. (*Vol. V., p. 93.*)

Some of the many applications of the craft of linoleum block printings and cutting. The craft has a wide range of application, for the blocks may be used for the production of all-over patterns for bookcraft work; patterns for fabric printing; monograms and devices for notices or book decoration; illustrations for hand-written books which are bound by the children; illustrations in black-and-white which may be mounted and framed as pictures, or illustrations in colour for decorative and pictorial purposes.

132. Cut Paper Illustration Work. (*Vol. V., p. 121.*)

All the examples are carried out in a simple way to make clear the manner in which colour areas are enhanced by the "mount" of surrounding and intermingling neutrals. The general effect is striking if somewhat crude, but in their composition, treatment and omission of unnecessary detail, they should be regarded as posters.

Using the same range of coloured papers as that employed for the first colour exercises compels the children to make use of their notes on simple colour schemes. It compels them to work "in the flat" throughout, in the decorative style suitable for posters, and it ensures that the correct range of hues, tints and shades is being used. In addition, the use of the papers enables the work to be done much more quickly and cheaply than would be the case if body colours were being used.

Accessories required are scissors, rulers, and tracing paper. Ungummed papers are recommended, as they are easier to store and to work with, and a stiff paste such as "Grip-fix."

In building up these poster designs from the original drawing, the largest area of paper is laid first and is carried right across behind the other detail. In succession, then, the remaining areas are pasted on partly over one another, the last ones being the isolated spots and accents which are placed on top. The children should not attempt to fit the parts together like a jigsaw puzzle.

133. Colour Wheel. (*Vol. V., p. 103.*) The construction and use of a colour wheel in coloured paper. The work looks best if carried out on either white or light grey paper. A $\frac{1}{2}$ -Imperial sheet should be used, and the wheel should be about 12 in. in diameter.

Building-up and lettering, on the same sheet, of details from the wheel provide a second useful exercise.

(a) A column giving the tint, hue, shade and neutral from any one colour in small squares.

(b) A double column giving the same from any two adjacent colours, with neutral and black.

(c) If light grey paper is available; one column giving black, neutral and white.

The opposite or complementary scheme is not introduced at the early stage, as it is unwise to risk confusion by too many details at once. The one-colour scheme and the related scheme, with the purely neutral one, give ample scope for first year colour exercises. Space should be left, however, for further additions at a later stage.

Consequent upon the two first exercises experiments in simple colour arrangement may then be made for use in simple design work.

A neat block of four fairly large squares is ruled

up on a sheet of white paper, with a margin between each one.

The first one is covered with a single piece of neutral paper. The children then select any one hue as a starting point, and they cut out a band of black paper which is, in width, about one quarter of the side of the grey square. They mark on the grey square the position of the second quarter down from the top edge, and then paste the black band across the grey at this position, so that one quarter of grey appears across the top, above the black, and half the square of grey remains, at the bottom. Next, a small circle of white is cut out, and this is pasted partly over the black, a little to the right of the centre, and partly over the grey ground, but at the lower edge of the black strip.

The second square is then treated in the same way by the children themselves, without direction, using any one hue instead of the white circle, and its shade instead of the black, on the neutral ground.

The third square is again covered with neutral, a shade being used instead of black, and its tint instead of white.

The fourth square is covered with any one tint. The shade of either of the two related hues replaces the black. The full hue of the ground tint replaces the white.

134. Illustrations—Water and Body Colour. (*Vol. V., p. 118.*) Three of the paintings shown in this Class Picture are imaginative compositions by senior children. The purpose of each is to test the child's ability to express his own idea of a common phenomenon, or a commonplace subject, in a pictorial form. Each picture

is carried out on a large sheet of paper with the use of both ordinary water colour and poster colour.

In each case the first essential is that the mood of the set subject should be clearly expressed; exactness of representation being of secondary importance in this type of drawing. For this reason the paintings must be done quickly, to convey the impression in a bold and vigorous style.

The landscape with trees shows the child's impression of the set subject "The Wind," and the effect of a strong wind is gained very effectively by the leaning trees, with their foliage blown to one side, and by the suggestion of scudding clouds in the sky. Such an original drawing shows a high standard of observation on the part of the child, along with retentive memorising powers.

A high sense of pictorial values is shown in the painting illustrating "The Storm." The effect is gained by harsh contrast of tone in a cold colour scheme combined with the lowering clouds, the rough sea and the jagged line of the rocks, in addition to the obviously distressed condition of the ship. In a painting of this type the effect would be spoiled by additional detail, or by precise and laboured drawing. But the composition is good, and the apparent crudity of the drawing is of no importance in comparison with the dramatic vigour of the picture as a whole.

The picture of "The Fisherman" is equally strong in effect. The vertical and horizontal lines which are used in the composition, in addition to the symmetrical lines of the figure—in a pose suggesting restfulness—all combine to convey this impression to the beholder. At the same time, the picture is brilliant in colour and

is handled with such simplicity that the lack of detail only adds to its force.

The flower picture is delightful in colour and it, likewise, gives an impression of the objects portrayed rather than an attempt to present them as an object drawing of the usual type. As a picture it is of infinitely greater value than is the laboured, lifeless and detailed drawing which is generally made of similar subjects.

It should be remembered, however, that these drawings follow a stringent course of essential drawing practice and composition exercises. It is impossible to obtain such results without the teaching of the necessary groundwork.

135. Illustrations in Various Styles. (*Vol. V., p. 119.*)

These paintings show stages of progression from the coloured drawing to the full representation in colour of a particular scene.

The drawing of the children playing in the school yard is vigorously done, but the colour is a secondary consideration and no technical problems are involved.

The painting beneath shows a group of buildings as seen from a schoolroom window, and it is remarkable for the way in which the subject has been disposed within the outlines of the panel to form an interesting composition as a pattern of varied shapes. Care has been given to the actual drawings as an exercise in perspective, and to the subsequent painting in which superimposed washes are used to get the required greys. A certain looseness of handling in the washes assists the pictorial effect without detracting from the drawing and thereby avoids the unpleasantness which

would result from outlines which were too hard and obtrusive.

The tree subject is a purely imaginative composition based upon the rule of variety in widths of spacing (between the tree trunks) combined with rhythmic cloud lines and a low horizon line. It is carried out in strong line, with the minimum of colour, and this type of drawing is of the greatest value for preliminary sketches made before the commencement of a full-colour illustration.

The remaining two paintings are of a more advanced character. The seascape is particularly interesting as it shows a confident handling of washes with considerable technical ability, combined with the use of the "S" line as a basis for the composition. Complications which would follow upon the introduction of an horizon line are avoided by carrying the foreground detail well up to the top of the picture. Interest is gained, also, by the contrast between the clean-cut edges of the quay and the softened foreground detail, and between the broken colour-greys of these parts and the bright touches of colour round the boats.

The last picture shows the value of an early insistence upon the study of tone contrasts. The picture is composed as a series of almost flat, superimposed washes, built up from the lightest tone value to the darkest accents in three stages. Later washes in the series are carried over portions of earlier ones, thereby giving additional intermediate tones with colour greys. Detail is reduced to a minimum, thereby giving a strength suitable for an architectural subject. The tonal pattern is assisted by the pleasing composition of the picture.

136. Natural and Common Objects in Water Colour. (*Vol. V., p. 184.*) Examples of advanced work carried out by painting a picture as a whole and not piecemeal. If the reproductions are studied carefully it will be seen that the warmer and lighter washes have been carried across the forms of individual objects and their surroundings, underneath the subsequent washes which may determine the outlines of these forms.

The procedure may be summed up as a progression from large, warm and light washes to small, dark and often colder washes. No more than three washes should appear at any one point as superimposed one upon the other, as this will cause the earlier washes to "lift" and will result in muddy colour and dirty, hard-edged patches in the last wash.

One important point is demonstrated in the second example. Children invariably represent drapery forms by curved lines, so that the forms lose their definite shape which has such strong pictorial value. Drapery folds, and the angles between them, should be represented by straight lines and painted as such. The smooth, thin materials with a dressed surface will be found to fall naturally into long straight lines and sharp angles. These folds throw sharply defined shadows with clean straight edges, and the actual painting processes will soften these just enough to obtain the suggestion of texture which is the test of a good painting.

137. All-over Patterns. (*Vol. V., p. 147.*) These sixteen examples show various methods by which all-over patterns may be produced. Units may be of various shapes such as the square, the diamond, the triangle, the parallelogram; or they may be entirely

free from any geometrical outline. In subject they may be purely geometric, or they may be based upon common objects—including the human figure—or upon natural objects such as flowers. In some cases they may be abstract forms which are unrelated either to common or natural objects.

They may be produced by outline drawing and painting, as in the case of those in the top row; by brush drawing as in the first two in the second row; by successive printings with linoleum stamps as in the third one in the second row; by printing with wooden sticks as in the last one of the second row and the first three in the third row, by stencilling as in the last one of the third row, or by printing from linoleum and wood blocks as in those of the fourth row. These latter prints are all carried out on fabric grounds, and the last one of all is a particularly beautiful pattern based upon the honeysuckle which shows how continuity of line, and unity as a whole, may be obtained in the most intricate design.

The first eleven of these patterns are suitable for end-papers or box-covers, whilst the remaining five are intended for hangings and other printed fabrics.

138. Designing Greeting Cards from Sketches. (*Vol. V., p. 144.*) Sketches made by the children during the year can be utilised to make most attractive and original Greeting Cards. The examples offer numerous suggestions for variations in treatment and very interesting practice is afforded in pattern, design and lettering.

139. Designs for Book Covers. (*Vol. V., p. 134.*) Illustrations of pattern applied to the crafts. A

development of the groundwork covered in the first year, showing a great improvement in style and execution. All the different methods of pattern production should be kept in use in the approach to more advanced work, and the children should be led to endeavour to plan, and to select, patterns which are most suited to the particular purpose in hand. Edge-stencils, linoleum-cut units and pen-drawn patterns will be found to be the most suitable types for the major portion of the work.

The drawing and painting of natural objects may be utilised for the purpose of revising early lessons in conventionalisation. Line drawings or water-colour drawings may be used for devising fresh types of units. Formal units obtained in this way often provide interesting patterns of a kind particularly suitable for book crafts.

140. Water Colour Methods. (*Vol. V., p. 115.*) Examples of methods used in direct water-colour painting. Other methods such as the use of paste colour, stippling, etc., which are more within the scope of the professional artist, are not included as it is considered wiser to concentrate upon the straightforward technique of pure water-colour painting when teaching senior children, in view of the limited time which is available for this class of work.

Fig. 1 shows the three fundamental washes used in painting in water colours. Practice in applying these washes is usually the first stage in the teaching of the art.

The first one is the flat wash, the second is the graded wash and the third an exaggerated instance of the

broken colour or variegated wash. In this case the colours are run on irregularly, being allowed to merge together by light touches of the brush.

Fig. 2 shows the use of these three washes for a rapid impression of a simple scene at the seaside. Very little preliminary drawing is necessary, and the whole sketch is practically finished in one wash, only a few touches of stronger colour being required to finish it when the first washes are dry.

A careful preliminary pencil drawing is made for Fig. 3 which shows the first washes used for building up a landscape sketch. Warm colours and light tones are used throughout, so that a few small superimposed washes, followed by the accents of small cast shadows, will complete the sketch.

A finished sketch carried out in exactly the same way is shown in Fig. 4.

The next example (Fig. 6) is done with a very large and fully charged brush on an absorbent ground such as cardboard. The board should be tinted grey or cream. As it is immediately absorbent, each wash or stroke must be absolutely direct in its application, and the colour retains its bloom and richness by being undisturbed.

Fig. 5 illustrates what is probably the best and easiest method for the children to adopt in the early efforts at imaginative illustration. The main parts are planned and a pencil sketch is made which includes only the main forms and lines. The colour washes are almost entirely in the flat, and they are of considerable intensity. The method is suitable for story illustrations and for small decorations such as those which appear on rhyme sheets in conjunction with lettering.

The last illustration is carried out entirely in body colour; i.e., colour which is entirely opaque but which is still water colour. It is a design for a landscape poster and represents the type of work up to which the cut paper designs should lead.

141. Science—1. (*Vol. VIII., p. 493.*)

THE ELECTRIC BELL. When the bell is pressed, an electric current supplied by the Leclanché cell passes through the circuit represented in red and energises the electro-magnet. The soft iron armature is pulled towards the magnet poles and so the hammer strikes the gong. The movement of the armature causes a break in the circuit at the contact screw and the electro-magnet is therefore switched off. The springy mounting returns the armature to its original position, the circuit is re-established and a second stroke begins.

THE ELECTRIC IRON. A heating element of nickel-chromium alloy wire mounted on mica is clamped within the iron to the upper side of the base. The two current-bearing cables from the mains are attached to the metal strips which form the termini of the element. The wire is arranged in the manner shown so that the heat generated is concentrated in a small space. When the current is switched on, the element glows red and heat is conducted through the iron base to the laundering surface.

THE VACUUM CLEANER. A small electric motor is coupled directly to an air fan and, through a rubber belt, to a beater consisting of bars and bristles.

The fan creates a partial vacuum in the neighbourhood of the carpet surface which is being treated and the beater disturbs grit and dust. Air rushing into the appliance carries the dirt from the carpet past the fan into the bag where it is retained. After having served as dust carrier, the air escapes through the pores in the bag fabric.

THE ELECTRIC CLOCK. An electro magnet with serrated pole pieces is energised by alternating current from the mains. Between the poles is a small iron rotor with teeth which correspond with those on the pole pieces. When given a start with the knob provided, the rotor continues to revolve steadily under the influence of the alternating attraction and repulsion of the magnet. A flywheel on the rotor shaft helps to steady the motion, and a gear wheel transmits the movement to the mechanism which actuates the hands.

THE TELEPHONE AND THE HUMAN EAR. Sound waves in the air strike the drum of the ear or telephone transmitter and cause this to vibrate. The external ear and the mouthpiece serve as collectors and guides of these sound waves. In the telephone transmitter the diaphragm movement compresses or releases carbon granules mounted in a cup immediately behind the drum. An electric current passing through the granules from the cup base to the diaphragm is influenced by the movement as the resistance of the transmitter depends on the state of the loosely packed carbon. This electric current carries the influence of the sound which is impinged on the diaphragm to a distant receiver.

The drum movement in the human ear is transmitted through a group of very small bones which may well be compared with the carbon granules of the telephone. Sensitive cells in the inner ear receive impressions from the stirrup bone and transform these into impulses which are communicated by nerve fibres to the brain.

142. Science—2. (*Vol. VIII., p. 494*)

THE SPRING BALANCE. A closely coiled spiral spring is fixed permanently at its upper end to the case of the balance. The lower extremity carries a sliding rod and hook to which the scale pan and load are attached. A pointer at the top of the sliding rod moves over graduations marked on the case. As the extension of a spring is proportional to the load stretching it, the weight of any object within the capacity of the spring balance can be read directly at the indicator.

THE GRANDFATHER CLOCK. A freely suspended pendulum consisting of a long bar and heavy bob has an anchor escapement fastened to it near the point of suspension. The escapement is set so that it permits the escape wheel with which it engages to move round one tooth for every swing of the pendulum. This action makes the clock keep time as a pendulum swings evenly at one definite rate.

In order to supply the energy necessary to keep the escape wheel turning and the pendulum swinging, a train of gears, a drum and a driving weight are provided. The weight pulls the drum round as it slowly descends, and the drum transmits the power through

the gearing. The pressure of the escape wheel teeth on the escapement is sufficient to keep the pendulum moving.

Shafts for driving the clock hands are connected to the gear train at appropriate points.

THE ELECTRIC LIFT. Cables working on pulleys connect the lift to a large balance weight which moves upwards as the lift goes down, and *vice versa*. This arrangement reduces very considerably the load applied to the driving motor.

Guides for both lift and balance weight are provided at the sides; spring buffers at the bottom reduce the shock caused by the lift striking the stops; an overhead electric motor unit supplies the necessary drive, and freely hanging cables connect the controls in the lift to the driving apparatus.

THE CRANK. In steam engines and other similar mechanisms it is necessary to transform the up-and-down or backwards-and-forwards movement of a piston into steady rotation. The crank is the means by which this is accomplished. The illustration shows a piston coupled to a crank through a crosshead and connecting rod. Each stroke of the piston corresponds with half a revolution of the crankshaft. To carry the machine over the "dead points" at each end of the stroke when the piston is changing its direction of motion, a heavy flywheel is fitted on the shaft.

THE MOTOR CAR CLUTCH. When starting, stopping or changing gear in a motor car it is necessary to disengage the engine from the road wheels. A

clutch is provided for this purpose. The illustration shows a simple friction clutch mounted between the crankshaft of the engine and the gearbox driving shaft. A set of plates fastened firmly to the crankshaft interlaces with another set mounted on the combined housing and driving shaft unit. When power is being transmitted a strong spring presses the sets of plates firmly together so that the friction between the surfaces is very great. With the spring in action the plates act as though they formed one solid mass.

When the clutch pedal is depressed the spring loading is relieved so that the sets of plates may turn independently of each other. When the engine plates revolve without driving the housing, the clutch is said to be *slipping*. As the pedal is slowly released the friction between the plates increases, the engine takes up the drive gradually and the clutch ceases to slip.

THE CROW BAR. This is an example of a simple lever. A comparatively small force or effort acting a great distance from the fulcrum is able to raise a heavy weight close to the fulcrum. The force or effort moves much further than does the weight to which it is applied.

THE COAL TONGS. In this case a double lever is acting. The forces applied by the hand are nearer to the fulcrum than is the resistant piece of coal. The grip on the coal is therefore less than that actually applied. Everyday experience bears out this conclusion, for with tongs of this type it is very difficult to grip firmly a heavy lump.

THE NUTCRACKERS. This simple machine is like a pair of coal tongs working the wrong way round.

The nut is gripped between the lever arms near the fulcrum and the hand is applied at the free ends. As all levers which have the resistance nearer to the fulcrum than the force or effort give a *mechanical advantage*, the nutcrackers apply a force to the nut which is greater than that applied by the hand.

THE WHEELBARROW. Nutcrackers are a double lever. The wheelbarrow is a single lever of the same type. Like the nut, the weight in the barrow is nearer to the fulcrum than the effort. Consequently the lift applied to the barrow handles is less than the weight.

SCISSORS. Scissors are a double lever of the crow bar type, the resistance being on the opposite side of the fulcrum to the effort. As the material being cut is nearer to the pivot of the scissors than the fingers which are doing the work, a mechanical advantage is gained.

143. Science—3. (*Vol. VIII., p. 495.*)

TOWN WATER SUPPLY. The diagram shows how water in a low lying reservoir can be supplied at adequate pressure to town water mains. Power driven pumps at a sub-station take in water from the reservoir and lift it to a tank at the top of a water tower. A service pipe from this tank leads directly to the house taps and street hydrants. As the level of the water in the tank is considerably above that of each service point, water flows freely throughout the system.

THE BALL TAP. This apparatus is installed in tanks and cisterns in which a constant water level is to be maintained automatically. The ball float follows

any variation in level and operates the tap mechanism whenever the water drops below the desired position. A sliding cylinder with a soft washer at one end is linked to the ball float through a pivoted arm. When the float is raised the washer is pressed firmly against the washer seating and the water supply is cut off, but when it is lowered the cylinder slides outwards so that water may pass freely to the tap outlet.

THE VACUUM BRAKE. This device, fitted to railway trains, offers a reliable and effective means of applying simultaneously the brakes on the wheels of every coach. A pipe running the whole length of the train is coupled to a cylinder at each braking point. By means of a steam operated extractor on the engine, the pipe and cylinder system is evacuated. Under these conditions the piston in the cylinder drops to the bottom of its stroke and the brake is off. When air is admitted to the train pipe by the engine driver, the guard or by accident, the lower part of the cylinder fills and the piston rises because of the pressure acting upon it. The vacuum above the piston is retained as a valve prevents the passage of air to this chamber. The rising piston applies the brakes through a system of levers represented diagrammatically in the illustration.

A PUMP. During the downward stroke of the pump piston shown in Fig. 1, air escapes from the lower part of the pump barrel through the open valve *a*. When the upward stroke begins, Fig. 2, valve *a* closes because the pressure inside the barrel is now less than that outside. At the same time valve *b* opens to admit water forced into the barrel by the air pressing on the liquid

surface in the tank. The next stage, shown in Fig. 3, is similar to the first although now water and not air is escaping through the piston valve *a*. As the piston rises again, Fig. 4, water is lifted to the level of the spout where it overflows, whilst valve *b* admits more water to the barrel.

THE WATER TAP. A domestic water supply is carried in service pipes at high pressure and so the stream leaving a tap which is turned on fully has a very considerable speed. As water is incompressible, a serious strain would be thrown on the supply pipe if such a flow were abruptly interrupted, as the moving column would hammer against the pipe walls. It is in order to avoid water hammering that a screw-down washer and seating design has been adopted for household taps.

A plunger unit carrying a soft leather or composition washer controls the passage of water from the tap inlet to the outlet. A threaded spindle worked by an external handle determines the position of the plunger. When screwed to the bottom the spindle holds the washer firmly on its seating. A gland and packing in the upper part of the tap prevent leakage of water round the spindle. A few turns of the handle allow the plunger to rise and leave a clear water course, but from this *open* position it is impossible to snap the control suddenly to *closed*.

THE HYDRAULIC PRESS. A small hand-operated pump is shown taking water from a large reservoir through one valve and forcing it through another to a strong metallic container in the base of the press.

A large diameter plunger in this container carries a platform on its upper end and upon this rest the articles to be compressed. As the quantity of water in the container increases the platform rises until its contents are trapped against the top of the machine. The diameter of the hand pump piston is only small and so the increasing pressure in the liquid does not produce serious opposition to its movement. But the press plunger is very big and the total force upon it due to the water pressure becomes very great as pumping continues. Consequently, the material on the platform is subjected to powerful compression.

A weighted release valve which opens when the limit has been reached, and a screw-down outlet stop are included in the illustration.

THE MERCURY BAROMETER. This instrument measures air pressure and the figures on the dial indicate it in terms of inches of mercury. In the position illustrated the air pressure is capable of supporting a vertical column of mercury 28.8 inches in height, this being the figure registered on the dial and also the difference in height between the long column on the left and the short one on the right.

As there is no air in the enclosure marked *vacuum*, the balance between the two columns of mercury is due to the air pressure exerted at the open end of the short tube. If the air pressure decreases, the long column will fall a little and the short one will rise. A change in mercury level will move the weight which is floating on the open surface. As this is coupled to the pointer by a cord, pulley and balance weight arrangement, an appropriate change will be shown on the dial.

Descriptive words on the dial suggest in a general way the kind of weather to be expected for each section of the scale.

144. Science—4. (*Vol. VIII., p. 496.*)

BOILER OF LOCOMOTIVE. In order to facilitate transfer of heat from the burning fuel to the water in a locomotive boiler, many fire tubes pass through the boiler from the combustion chamber to the smoke box. Hot gases from the fire travel along the tubes and give their heat to the water. Steam from the boiler enters the cylinder after passing through a valve which is controlled by the engine driver. Exhaust steam leaves the locomotive via the smoke box and funnel. A safety valve provided at the top of the boiler acts as a safeguard against excessive steam pressure.

THE STEAM ENGINE. Two moving parts of a steam engine are represented—the piston and the slide valve. Three steam passages are shown. The two outer ones open into opposite ends of the cylinder and the centre one is the exhaust port leading to the open air. Red dots in the drawings represent high pressure steam supplied to the steam chest by the boiler. Red circles represent low pressure steam.

In Fig. A., the slide valve is pushed over to the left. Steam is entering the right hand end of the cylinder from the steam chest and is forcing the piston over to the left. Low pressure steam in the left hand end of the cylinder is being swept out through the exhaust port.

Fig. B shows the piston about to start its return stroke. The slide valve has moved over to its alternative position and so the right hand passage now opens into the exhaust port. High pressure steam entering the left hand end of the cylinder pushes the piston back along its path, and the spent steam on the right is cleared out. The slide valve changes its position at the end of every stroke so that the engine may act continuously.

THE GAS ENGINE. The engine crankshaft carries a heavy flywheel and is coupled to the piston by means of a connecting rod. Four cams, mounted on a common camshaft, are driven from the crankshaft through two pairs of bevel gears. The cams operate the air, gas and exhaust valve and the ignition slider.

In the position illustrated the gas and air valves are open and a charge of mixture is entering the cylinder as the piston moves out. As the piston returns up the cylinder on its next stroke the valves are closed and the mixture therefore becomes compressed. At the end of the stroke a cam raises the ignition slider, the flame ignites the compressed gases and the rapidly expanding burning mixture forces the piston down the cylinder. During the return movement, the exhaust valve is held open by its cam so that the products of combustion can be cleared out before a new charge of mixture is admitted on the following stroke.

As the engine develops power only on one stroke in every four, a flywheel is very necessary. This gives smoothness to the movement by storing energy and spreading the effect of the power stroke over the three idle strokes of the cycle.

THE FOUR STROKE MOTOR ENGINE. Two valves fitted in the cylinder head control the inlet and outlet ports and an electrically operated sparking plug provides the means of igniting the petrol and air mixture.

The first diagram shows a charge of petrol vapour and air being taken into the cylinder from the carburettor through the open inlet as the piston descends. The second shows this mixture being compressed by the rising piston. At the top of this stroke a spark occurs at the plug points and the gas fires. An early stage in the power stroke which follows the firing is illustrated in the third drawing. At the end of the power stroke the exhaust valve opens and the used gas is expelled. By the end of this stroke, shown in Fig. 4, the engine is ready to recommence its cycle.

The spring and cam mechanism which operates the poppet valves and the water jacket which keeps the cylinder at a reasonable working temperature are clearly illustrated.

145. Science—5. (*Vol. VIII., p. 497.*)

THE THERMOS FLASK. A double-walled glass bottle is supported on felt or cork pads inside a metal case. The enclosed surfaces of the bottle are silvered so that they will reflect and not transmit heat radiation falling upon them from the hot contents. The space between the walls is evacuated in the course of manufacture so that heat cannot escape by conduction. The pads, the silvered walls and the vacuum together keep down the heat loss to a remarkably low level.

THE ELECTRIC REFRIGERATOR. An electrically driven compressing pump forces a quantity of sulphur dioxide continuously through a closed circuit of pipes. The compressed gas leaving the pump passes through the condenser in which it cools to normal air temperature; the gas then liquefies owing to the pressure to which it is subjected. After passing through a regulator valve the liquid enters the evaporator where the pressure upon it is greatly reduced. The liquid vaporises rapidly, extracting heat from its surroundings as it does so. Foodstuffs stored near the evaporator in the refrigerator cupboard are therefore cooled. The gas produced by the evaporating liquid passes on to the pump to be compressed prior to starting the cycle again.

CENTRAL HEATING AND HOT WATER SUPPLY. Water in the boiler, on being heated, expands and rises, passing along the upper connecting pipe to the hot water cylinder. The hot stream flows upwards in the cylinder whilst cold water from the supply tank enters at the bottom and moves across to the boiler through the lower pipe. As a result of this circulation the water at the top of the cylinder becomes hot, although the temperature falls towards the bottom. The hot water taps are connected to the top of the cylinder so that the hottest water can be drawn off when required. From the same point pipes lead to the radiators. The cool water returns from these to an inlet situated a short distance down the cylinder. Owing to the difference in level between the radiator supply and return pipes in the cylinder a circulation is established.

The water movement through the boiler, cylinder and lower pipes is called the *primary circulation*. That through the radiators, cylinder and upper pipes is the *secondary circulation*.

THE MINER'S LAMP. Owing to the special design illustrated, the naked flame of this appliance is unable to ignite explosive gas existing in the atmosphere of the coal mine where the lamp is being used.

The fuel container and burner which form the lamp base are fastened to a short wide glass tube which serves as a window. A cylindrical metal gauze with suitable supports and projecting bars is mounted above the glass. Air passes freely through the gauze to feed the lamp flame and when the mine contains gas this also enters.

Both fuel and gas are able to burn inside the gauze, but no flame penetrates the mesh to ignite the gas outside, because the metal gauze rapidly conducts heat from points where it is concentrated and distributes it to the cool atmosphere so effectively, that nothing outside the lamp is able to attain the ignition temperature of the gas.

CHIMNEYS IN A HOUSE. Chimneys bend at one or more points in their course so that rain cannot beat directly on to the fire and so that the grate will not "smoke." It is therefore possible to have a number of fireplaces one above the other in a building as illustrated. Each grate is entirely independent of the others, and the chimneys bend inwards near the top to form a convenient group.

146. Science—6. (*Vol. VIII., p. 498.*)

THE PERISCOPE. Rays of light normally travel in straight lines and it is therefore impossible to see directly over tall obstacles or round corners, although by using a periscope which incorporates a reflecting system an indirect view can be obtained. In the simple instrument shown in the illustration, the rays of light from the scene over the wall are reflected down the hollow case by the upper mirror. A second mirror at the bottom turns the rays in a horizontal direction so that the observer may stand in a comfortable position. The red line on the drawing shows the path of a typical ray.

THE HUMAN EYE AND THE CAMERA. A *lens* is used in both the eye and the camera to produce a clear image of a scene on a sensitive surface. The camera has a glass lens and a sensitive surface of chemically treated gelatine on glass or celluloid. The eye contains a lens of a stiff clear jelly material and a sensitive surface of nerves. This surface in the eye is called the *retina* and it is linked to the brain by the *optic nerve*.

Each point on the object which is being seen or photographed sends out rays of light in all directions. Those rays which enter the eye or camera are bent by the lens so that they all meet at one point on the film or retina. As this occurs for every part of the object, a complete image is built up on the sensitive surface. The rays from the upper and lower parts of the object cross at the lens and the image is therefore inverted.

A device for controlling the aperture through which light is admitted exists in both eye and camera. In

the eye this iris or diaphragm works automatically, closing up when the light is bright and opening when it is dim. The effective diameter of the camera lens can be adjusted manually by a small lever which controls the iris. The word *iris* is usually applied to the diaphragm in the eye and *stop* to that in the camera.

Both the eye and the camera can be adjusted or *focused* to suit objects at different distances. The eye has a system of muscles which can alter the thickness of the lens by pulling at its periphery; these muscles hold the lens in the shape which corresponds with the distance of the object under examination. The camera has leather bellows which can be racked in or out to change the distance between the lens and the sensitive surface.

THE OPTICAL LANTERN. Light from a powerful lamp inside the body of the lantern is concentrated on to the glass slide carrying the picture by a reflector and a thick double lens of large diameter called the condenser. An objective lens at the front of the instrument projects a greatly enlarged image of the brightly illuminated slide on to the screen.

Apart from the special steps taken to illuminate the slide, the lantern works in a very similar manner to a camera although the image which it produces is larger than the object whilst that in a camera is smaller. The objective lens is mounted in a sliding tube on adjustable bellows so that its distance from the slide can be varied for focusing purposes. Like the camera, the optical lantern produces an inverted image. The slide is therefore inserted in its carrier the wrong way up so that the image may be formed correctly.

BINOCULARS. Two groups of lenses are fitted in each half of a pair of binoculars, and these groups have to be a considerable distance apart in order to produce the required enlarged image. For convenience in handling however it is essential that the whole instrument be kept down to small dimensions. The illustration shows how the necessary length is packed inside reasonably short tubes.

Light entering the instrument from a distant object passes through the objective lens and then down the tube. At the end it strikes a glass prism in which it is reflected twice internally so that it emerges and travels back along the tube by a path parallel to the original. Another double reflection occurring in the second prism directs the light towards the eyepiece lens through which it passes to the observer's eye. The red dotted line in the drawing represents the lengthy path along which the light travels inside the instrument.

147. Science—7. (*Vol. VIII., p. 499*).

OPTICAL ILLUSIONS. The eye usually transmits very reliable impulses to the brain and the brain usually interprets these accurately. The illustrations show interesting cases where the combination comes to grief! To see the illusions to the best advantage the card should be held at arm's length.

1. The sides of the square are perfectly straight although they appear to bow inwards.

2. At first the observer recognises the drawing as a view of some steps taken from above. Then it changes and appears as a view from underneath.

3. This appears at first to be a view looking down

on an oblong box, but this also changes to an upward view.

4. The two dotted circles are exactly the same size although the others near them make the sizes appear different.

5. The curved markings do not form a continuous spiral as might be supposed. By following them round it will be seen that they form circles.

6. The bold lines running across the circle are all parallel although they appear to converge in pairs.

7. The long sides of the four rectangles are all perfectly straight and parallel.

8. The horizontal lines between the rows of blocks are all parallel although they seem to be twisted to most peculiar shapes.

9. The two central circles are equal in size but the one on the right appears to be much larger than the other.

10. The two horizontal lines are the same length but the arrangement of arrow heads makes them appear different.

11. The blocks in this pattern appear at one time to be pointing downwards and at another to be pointing upwards.

148. Woodwork Joints—1. (*Vol. VIII., p. 500*).

BUTT HALVING. Used for extending the length of a member while retaining a flush surface, as in the case of a wall plate, rail or ridgepiece. The joint should always occur at the top of a post or stud so that it receives support from underneath, or on a wall, or other supporting rail. It is secured by either nailing, screwing, bolting, or by wooden pegs.

CORNER HALVING. The commonest joint connecting timbers at a right-angled corner, as in the case of the wall plate of a fixed structure. Usually nailed direct on to the top of the post. It may be used for rough frames, when it is dowelled with wooden pegs instead of being nailed.

TEE HALVING. A common joint for cross-members acting as struts for the purpose of holding other members parallel. It is not suitable for any case where an outward pull or thrust is exerted. Again, it requires underneath support owing to weakening of the lower member.

DOVETAIL HALVING JOINT. This is a strong joint for flush-faced framings, and is not affected by shrinkage to the same extent as the ordinary "Tee" halving joint. It may be used for ties, at various angles with connecting members, and in positions where tensional stress is exerted.

ANGLE DOVETAIL JOINT. The strongest joint for corner framing, where the face of the stuff meets the joint instead of the edge. A useful joint for the corners of side frames in portable buildings.

TEE BRIDLE JOINT. A good joint for all kinds of light framings, though not easier to make than the mortise and tenon joint. It may be used for members which meet at an angle other than the right angle.

To hold this joint securely, it is customary to insert a wooden pin or dowel, which may be round or square in section. This pin is put in in such a manner that it pulls the shoulders of the joint up tightly as it is

driven home, and this pull is ensured by boring the hole in the middle section of the joint a fraction nearer the shoulder than the holes in the outer sections. The method is known as "draw-boring," and is shown in the diagrams.

ANGLE BRIDLE JOINT. This joint is not at all easy to make, as it requires very accurate sawing to obtain a good fit without the jaws of the "bridle" member being forced open at the outside edge.

The joint is used for similar purposes to those mentioned above, for which the "Tee" bridle joint is suitable, including all kinds of flat framings which are not subjected to great stress in use.

THROUGH MORTISE AND TENON JOINT, SHOULDERED. Used in the framing-up of doors and other structures. Probably it is the commonest joint to be employed in the outdoor woodwork course.

STUB MORTISE AND TENON JOINT. A common variety of mortise and tenon in building construction where a wooden member has to be joined to one of stone, etc. It is used more for the purpose of keeping the former in position.

BARE-FACED MORTISE AND TENON JOINT. So called because it is shouldered only on one side. Used when it is required to place the tenon member out of centre on the leg or post to which it is joined, and when an extra strong tenon thickness is desired.

DOUBLE MORTISE AND TENON JOINT. In large and thick stuff used for heavier work a single

tenon would necessitate a mortise so large that the mortise member would be seriously weakened at one point. To avoid this, two separate mortises are used with a double tenon. In any case, this forms a much stronger joint than would be made by the single tenon alone.

MITRED SHOULDER. Two forms of the joint are shown, both of which require to be secured by nailing, and to be strengthened by glue blocks if possible.

MASON'S MITRE. To enable the full width of the stuff to be retained at the joint, and to avoid the scribing of the rail shoulder, the moulding may be stopped and mitred in the solid. The objection to this method is that the moulding cannot be cut with a plane on a short length, so that a scratch stock has to be used, and the mitres have to be finished by hand on the stiles.

SCRIBED JOINT. This form of joint is difficult for boys to attempt, but it is used very largely—in various forms—in the jointing of window frames and sashes.

CROSS HALVING. Used for two members crossing at any angle—or at approaching the right angle—but which have to be kept in the same plane. It is most suitable for vertically placed members such as rails or sills crossing braces or studs. It may be used for horizontal framings where the weight is not heavy, and when not subjected to sudden shocks.

CROSS DOVE-TAILED HALVING. Used as an occasional alternative to the plain cross halving to give

additional assurance of rigidity—also in case of probable shrinkage causing side play.

The dotted line in the diagram shows the second alternative by which both shoulders are dovetailed, but this is usually not necessary.

149. Woodwork Joints—2. (*Vol. VIII., p. 501.*)

PLAIN HOUSING. The whole of the end of one member is let in to the thickness of the other. Sills and rails may be jointed to upright members in this way.

"Notched." When one member is housed into a wider member than itself, so that the groove in the latter is "stopped," the joint is often known as a notched joint. This occurs, for instance, at the join between the ends of ceiling joists and their supporting beams.

TONGUED JOINT. This term is usually applied to the variety of housing joint in which the two members meet at a corner, one of them being shouldered. It is used for light framings where both members are securely held by other means in addition, and where there is no sideways stress.

DOVETAILED, HOUSED OR TRENCHED JOINTS. Common to both cabinet work and light framings, but not very common, or ordinarily necessary, in outdoor work. Housing joints are used extensively in staircase work.

REBATED AND HOUSED JOINT. The shoulder across the end of the tongued member assists in obtain-

ing rigidity and in holding this member firmly at right angles to the other one.

SECRET MITRE DOVETAIL JOINT. This is the strongest joint which can be used to give a mitred edge view, with an unbroken surface on each face of the stuff right up to the corner.

The diagrams show the stages in marking-out and cutting the joint.

A common instance of its use is in the upper carcass joint at the side of a writing bureau, on which there is no moulded top edge.

It is the best joint to use in the groundwork for veneering, as there is no end grain left to be veneered over, and the plane surfaces that it gives are suitable for French polishing.

BUTT MITRED JOINT. The simplest form of mitred joint, but suitable only for temporary rough work of a light nature. It is secured by nailing. Glue blocks should be fitted inside the corner, if possible, to give more strength. An example of its use is shown below.

CROSS-TONGUED MITRED JOINT. In this case, two narrow grooves are cut at right angles to the face of the mitre, one on each piece, and for a depth of $\frac{1}{4}$ in. in light stuff, Fig. 27. A key of cross tongue is then prepared which is cut across the grain of the wood, and which is trimmed until it is a hand-tight fit in the grooves. The joint is secured by gluing the cross tongue into place, and cramping up.

This is a strong joint, suitable for plinth bases when reinforced by glue blocks in the angle of the joint.

SHOULDERED AND MITRED BUTT JOINTS.

Two forms of the joint are shown, both of which require to be secured by nailing, and to be strengthened by glue blocks if possible.

REBATED ANGLE JOINT. Suitable for light and rough work, such as moulds for light concrete paving blocks, or for window boxes in wider stuff where a flush outer surface is necessary for fitting in a recess. Whilst not a strong joint, the shoulder prevents leakage due to poor fitting and adds considerably to the strength. The joint becomes sound for many purposes if the inside faces of the wood are given two coats of paint to render the job watertight and to give a protective finish.

REBATED AND BEADED JOINT. Used where a good fit is difficult or impossible to make, and where the members have to be assembled separately in position. Only used, however, where the prominence of the end grain does not matter.

150. Woodwork Joints—3. (*Vol. VIII., p. 502.*)

BIRD'S MOUTH JOINT. This joint is used in buildings of all types and sizes where the common rafters, carrying the roof, meet the wall plate.

Fig. 1 shows the form it takes when the roof is required to overhang the walls, as is customary in the case of a span roof with a centre ridgepiece. The portion to be cut from the common rafter is best marked out from a template which has been adjusted to the pitch of the roof. The joint is secured by nailing through the rafter into the wall plate.

Fig. 2 gives the alternative form of the joint, which is used when overhanging eaves are not desired. This reversed form allows the inner shoulder, coming against the edge of the wall plate, to take the outward thrust directly, and makes the joint a very strong one. This also is secured by nailing, as shown in the diagram.

In brick buildings, the wall plates should be bedded securely along the top of the walls, either by cementing them in or by carrying up the outside course to leave a bed along which they may lie. The general custom at the present day, however, is to place the wall plate on the outer course of the brickwork, thereby obtaining a great deal more air space over the whole area of the roof, and between it and the ceiling beneath.

In wooden buildings, the wall plate is provided by the top rail of the framing on each side.

RIDGE JOINT. At the head of the rafters, in the ordinary light span roof, the joint is formed by trimming the ends of the rafters to butt against the ridgepiece. The ridgepiece is shown by dotted lines.

The joint is secured by nailing at an angle through the ends of the rafters into the ridgepiece, and for additional strength, a cleat may be nailed across the rafters in the manner shown. This cleat is to receive the ridgepiece.

NOTCHED JOINT. If the distance between the ridge and the wall plate exceeds 8 ft., one or more purlins should be put in to support the common rafters. The purlins are supported by the end walls, and their real purpose is to take some of the weight of the roof,

which otherwise would tend to thrust out the side walls.

Purlins are seldom needed in small buildings except in the case of lean-to roofs. Note the notched joint which should be used between the rafters and the purlin on such roofs, or on other roofs which are steeper than the average pitch of $\frac{1}{4}$ to $\frac{1}{3}$ of the span.

JOINT FOR COLLAR-BEAM ROOFS. This type of roof is used for buildings which have a span of from 12 ft. to 18 ft. A shed or workshop having such a span might be needed for a special purpose, and therefore some necessary details are included here.

The collar-beam roof is really the same thing as the couple roof with the addition of a tie rail. This rail, known as a collar beam, converts each pair of opposite rafters into a light truss, resisting the spreading tendency of the heavier roof which follows upon the increase in width of span.

The dovetail joint used at the junction of the tie rail with the rafter is shown. The principle is that of the halving joint.

JOINT USED FOR BRACES, BRACKETS AND ROOF-MEMBERS. The joint called the tie-beam joint is a variation of the bridle joint which is used a great deal in light building work, particularly, as its name implies, in roof trusses, and also at the ends of braces or struts. Detail is shown on the right.

The square shoulder at the end of the brace makes the joint exceptionally strong for its purpose, which is to enable the brace to hold the outer framing rigid against any side thrust tending to "fold" the whole

framework. As it operates only against a thrust in one direction, it is customary to add a second brace sloping the other way. Details of arrangement vary in individual cases, but the commonest form of brace is one which is fitted diagonally between opposite corners of a rectangular framing.

The danger attaching to this joint, in which the ends of the brace are shouldered to fit in the angle of the framing, is that under pressure the brace tends to force open the corner joints of the framing.

This is avoided if the tie-beam joint is used, as the end of the brace does not bear into the corner but is some distance from it.

An alternative form of the same joint is shown in Fig. B in which a "stump" tenon is used, and this style is adopted for heavy material under stress. The mortise is shown by the side.

The commonest purpose to which the joint is put is for a bracket made to support a wide shelf, or a fairly heavy weight.

Brick walls must be plugged before brackets can be screwed home, and to do this the holes are made with a cold chisel. After each blow given by the hammer, the chisel is turned slightly in the hole so that it is continually rotating while the hole is being made. This movement prevents the chisel from becoming jammed or "wandering," and enables a clean, straight hole to be cut. The plug should be cut from straight-grained wood, and should *not* be smoothed up on its outside surface fitting in the hole. For heavy work, hardened plugs should be used, of such a size that they will just enter the hole cut to receive them, and slightly wedge-shaped in length. Careful attention should be

given to the plugging of walls, as any slackness may result in a bad accident when the plugs pull out, as they will do if they are not properly fitted. A useful application of the tie-beam joint is for various framings in which the inner vertical members or "studs" need bracing. The studs should be cut, fitted up to each brace and then nailed.

CASEMENT SASHES. The details of a simple window frame for a shed are given in the bottom and second row diagrams. Two casement sashes are fitted, which open outwards from a centre member of the frame known as a mullion.

The diagram shows two methods of arranging the tenons at the ends of the jambs. In the first case (A), the tenon is barefaced on the inside of the jamb so that a shoulder may be left on the outside for sufficient width to allow the head and sill of the frame to be cleaned off flush with the jamb.

In the case of B, the width of the tenon is made from the full thickness of the jamb. This is made possible by leaving on the horns, as shown at the other end of the frame, so that there is plenty of strength beyond the mortises on the head and sill.

The mullion is rebated, or throated, on both sides, to allow the sashes to close in flush with the frame. They are then held by the ordinary casement catches.

The sash construction shown is of the standard type in which the rails and styles are made of rebated and moulded stuff having intervening sash bars. Instead of the moulding, a plain bevel may be substituted. Whatever the section through the rails, styles and sash bars may be, it is customary either to frank the ends

of the bars into the rails and styles or to scribe them, the former method being preferable. The crossing of the sash bars is carried out either as shown, by halving them; or by franking them with mortise and tenon joints, as in the next diagram. The latter method is the stronger, but the former ensures the two apparent halves of the cross bar being in a straight line.

There is a difference between these sash bars, and the glazing bars used in cabinet work. Sash bars are in one piece in section, and therefore they have to be jointed in the manner shown. The glazing bars, on the other hand, are built up, the rectangular spine being halved at the cross joins and tenoned into the rails and styles, after which the moulded section is planted on to it—being grooved along the back for this purpose—and mitred at the joins. The inside corners of the spine are strengthened by gluing in pieces of stout paper, linen or mull.

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